THE AMERICAN GAS LIGHT JOURNAL

REDMANRKENNY.N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXIII.—No. 6. Whole No. 1,313. | NEW YORK, MONDAY, AUGUST 6, 1900. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Representatives of the New England Association of Gas Engineers at the International Gas Congress. 201

EDITORIALS—
Briefly Told 201
Representation at the International Gas Congress on Behalf of the Western Gas Association—A Slacking in Iron Prices—Notes.
Eighth Annual Meeting, Pacific Coast Gas Association.—Official Report. Revised by the Secretary—Continued from Page 165..... 202
First Day, Afternoon Session—*Some Notes on Larger Types of Gas Engines, by Mr. J. B. Crockett—Discussion—Committee to Nominate Officers—Report of Committee on President's Address—Naming a Representative at the Gas Congress—The Use of Crude Petroleum for Firing Benches—Discussion.
Natural Gas as an Important Factor in the Pittsburg District..... 209
*The Use of Acetylene Gas as Fuel in Chemical Laboratories, by Mr. Arthur Lachman 209
Elber's Method for Using Mineral Wool..... 211
Dearer Fuel in Great Britain..... 212
British Regulations Concerning the Distribution of Electricity 212
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 213
Objecting to the Gas Rate in Newtown, Queens, L. I.—The Jerseyville (Ills.) Light, Heat and Power Company—Proposed Gas Works for Chamberlain, So. Dak.—The Camden (N. J.) Company Changes Hands—Annual Meeting, Spencer, Mass.—Increasing Gas Output, Chicago—Another Paragraph over the Betterments at Bridgeton, N. J.—Mr. John Clements Takes Charge at Salinas City, Cal.—Annual Meeting, Northampton, Mass.—Advertising Dodges, Sunbury, Pa.—Mr. L. A. Bertholf in Charge at Downington, Pa.—Gas Sendout Phila.—New Works for the Pittsfield (Mass.) Company—The Foreign Trip of the American Institute of Electrical Engineers—Consolidation at Oakland, Cal.—And Other Items.
The Combination of Gases by the Agency of Spongy Platinum..... 214
The Market for Gas Securities..... 215

[OFFICIAL NOTICE.]

Representatives of the New England Association of Gas Engineers at the International Gas Congress.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., July 31, 1900.

Mr. Walter R. Addicks, President of the New England Association of Gas Engineers, has appointed the following members to represent the Association at the International Congress of Gas Engineers, to be held at the Universal Exposition, Paris, France, next month:

Mr. A. B. Slater, Providence, R. I.
Mr. Chas. D. Sherman, New Haven, Conn.
Mr. Walter S. Allen, New Bedford, Mass.

N. W. GIFFORD,
Secretary.

BRIEFLY TOLD.

REPRESENTATION AT THE INTERNATIONAL GAS CONGRESS ON BEHALF OF THE WESTERN GAS ASSOCIATION.—The members of the Western Gas Association, appreciating the importance of having that body well represented at the International Congress of gas men, to be held in Paris the first week in September, may rest assured that its informal delegates so far named will be quite up to doing it justice. As a certainty we know that Mr. William McDonald, of Albany, N. Y., who presided over the Western's deliberations last May, Mr. George G. Ramsdell, President of the American Gas Light Association, and Mr. F. H. Shelton, of Philadelphia (Editor of the Western's "Wrinkle Department,") will leave New York for the Exposition, sailing the 15th inst. That is a pretty good representation all around, and the further thought is the delegates or representatives will be met on the other side by Mr. I. C. Copley, President elect of the Western, and by Mr. A. W. Littleton, the Past Secretary and Past-President of the Association, respected and revered by all. A feature of the Western's representation at the Congress will be the reading of a paper by Mr. Shelton on the subject of high pressure gas distribution. Good luck to the voyagers, and on their return we will look for a good account of the impression they made. They will be home before the meeting of the American Gas Light Association in Denver the following month. Again, good luck to them.

A SLACKING IN IRON PRICES.—Every reasonable indication at the time is that the 1899 prices for any sort of manufactured iron will not again be seen in America for years, and many of them. America is productive of pigs of all sorts; but it is a fair thing to say that no one within the borders of our strong and rugged land was prepared for the output of pig iron that has been witnessed here since 1898. The putting of a price that enabled the ore mine owners to see the scantiest sort of profit ahead for the crude started every blast furnace and mill going, with the result that the prices for plates, pipes and the like are now within reason, and the outlook is that in the near future they'll be still closer to the purchasing power of those who, like the operators of gas

companies, are continually struggling to avoid the devil, ever keeping in remembrance the depth of the sea.

NOTES.—The proprietors of the Clinton (Iowa) Gas Light and Coke Company have made a special rate for gas sold in fair quantity for the night illumination of the show windows of shops.——Mr. F. H. Shelton, of Philadelphia, has been appointed a Voting Trustee for the Hutchinson (Kas.) Water, Light and Power Company.——The proprietors of the Consolidated Schuylkill (Pa.) Gas Company have decided to erect a new and commodious office building ——Last month "Uncle Jerry" Howard, of Galena, Ills., affirmed his marriage vows there to his first and best girl. In July, 1850, he was united in marriage to Miss Mary E. McCoon, both residents of Brooklyn, N. Y., and in the subsequent battle of life each was to the other a tower of strength, and though silver and gray are more prominent in their headpieces than are brown or black, the mutations of time still witness the golden affection that unites and controls them. Their golden wedding celebration was a well-attended event in Galena, for there were their children and grandchildren, mingling merrily with the friends (about everyone in Galena) gathered to pay social tribute to "Uncle Jerry" and his silver-haired wife.——A recent issue of the Columbus (Ohio) *Dispatch* calls attention editorially to the fact that the promoters of the Federal Gas Company, who proposed to supply gas for fuel proposes (either natural or artificial) at a great concession from the charges of the Columbus Gas Company, have shown no disposition to avail themselves of their franchise rights, although many months have passed. The *Dispatch* surely knows the reason therefor; and a simple business reason it is. Nothing more than the certainty that the Columbus Gas Company is serving the residents well and at a fair charge. ——The United Electric, Gas and Power Company, of Los Angeles, Cal., has assumed the direction of the gas and electric lighting interests of Santa Barbara, Cal. Mr. Carlyle C. Davis has been appointed local manager.——The gas rate at Fredericksburg, Va., has been reduced to $1.25 per 1,000 cubic feet. The works are under municipal control, and the Council has authorized its Light Committee to advertise for bids for the constructing and installing of an arc and incandescent electric lighting plant.——A correspondent incloses the following, from the Lowell (Mass.) *Citizen*, of July 31st: "The annual meeting of the stockholders of the Lowell Gas Light Company was held yesterday, when the following Directors were named: Sewall G. Mack, Levi Sprague, Jacob Rogers, A. G. Cumnock, E. M. Tuck, George H. Motley and E. N. Burke. S. N. Raymond was elected Clerk. Mr. Mack declined a re-election as President and Mr. Jacob Rogers declined a re election as Treasurer." At the organization meeting Mr. Jacob Rogers was elected President and Mr. Motley was elected Treasurer. The only reason for the changes named is that Mr. Mack had reached an age where it was better for the interests of the Company that he should no longer serve it as its executive head. The Board passed a very hearty memorial tribute to him for his services as its presiding officer for something over 20 years.——Mr. W. H. Lawson has been re-elected Superintendent of the Peoples Gas Company of Rutland, Vt.——Mr. Charles H. Nettleton, of the Derby (Conn.) Gas Company, has authorized an important overhauling of its main system.——At the annual meeting of the Fall River (Mass.) Gas Works Company the following officers were elected: Directors, J. S. Brayton, C. M. Shove, Geo. P. Brown, Jos. A. Baker, S. T. Bodine, Randall Morgan and Walton Clark; President, John S. Brayton; Vice-President, Joseph A. Baker; Clerk and Manager, George P. Brown; Treasurer, Lewis Lillie; Asst. Treas., James Ball; Supt., Jos. E. Nute.——As a result of the gas contest at Peoria, Ills., now that a combination of the warring interests has been perfected, the selling rate on lighting account has been raised to $1 15 per 1,000.——The capital stock of the Parsons (Kas.) Water and Gas Company has been increased to $300,000, from $200,000.——At the annual meeting of the Beverly (Mass.) Gas and Electric Company the officers chosen were: Directors, S. W. Winslow, H. F. Winslow, A. W. Rogers and C. F. Prichard; President, S. W. Winslow; Clerk and Treasurer, A. W. Rogers.——At the annual meeting of the Dedham and Hyde Park (Mass.) Gas Company the officers chosen were: Edwin E. Witherby, S. R. Bertron, Richard S. Storrs, Chas. G. Farwell and Charles E. Hellier; President, E. E. Witherby; Treasurer, S. R. Bertron; Secretary, Edwin M. Walker. The Company contemplates giving up the manufacture of gas in the near future, in that it has made a contract with the Massachusetts Pipe Line Gas Company for its supply, and expects to make a reduction in the selling rate as soon as connections are made with the Pipe Line Company's system.——It is thought that the works of the Kings County Gas and illuminating Company, Brooklyn, N. Y., the generating division of which is of the inclined retort order, will be put in active operation by the 15th.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.—CONTINUED FROM PAGE 165]

EIGHTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

HELD IN SAN FRANCISCO, CAL., JULY 10, 11 AND 12, 1900.

FIRST DAY—AFTERNOON SESSION.

The Association reconvened at 2:30 P.M. The President introduced Mr. J. B. Crockett, of San Francisco, who read the following paper, entitled

SOME NOTES ON LARGER TYPES OF GAS ENGINES.

When I told the Secretary of the Pacific Coast Gas Association that I would give him a few notes on the larger types of gas engines I had not intended to write a paper, but simply to make a few remarks at the meeting, covering in a brief way the points; but at his urgent request I have concluded to write a short paper upon the subject. It may not be out of place here to quote from Bryan Donkin, who, in speaking of the early combustion engines, says:

"The earliest attempts to obtain motive power from heat were made by igniting inflammable powder and utilizing the force of the explosion thus generated. As a source of energy this combustible powder was the first agent used; it preceded the production of coal gas or of steam. Strictly speaking, cannons are the oldest heat motors, and the principles on which they are constructed are identical with those of internal combustion engines. Heat is applied to explosive powder, and the expansion of the powder furnishes the motive force to propel a ball forward. In modern heat engines a piston takes the place of the ball. In the early days of mechanical science the energy shown in the projection of a cannon ball seems to afford a simple solution of the problem how to obtain power and motion by heat. But the power produced by exploding powder in a cannon could not be used for practical work, because it was not generated continuously and regularly. To apply the expansive force of the gases given off during combustion, the combustible was exploded in a closed vessel and made to act upon a piston. These early combustion engines were the forerunners of modern gas motors, in which the power is also obtained by explosion. But though they were introduced nearly 100 years before the first steam engine, they were soon abandoned because it was found impossible to control the power generated. Steam was easier and safer to work with, and for more than a century explosive engines were wholly relinquished."

He further says that Abbe Hautefeuille, the son of a baker at Orleans, was the first to obtain power, and had the honor of designing not only the first engine worthy of the name, but the first machine using heat as a motive force and capable of producing continuous work. But in 1680 Huyghens was the first to employ a cylinder and piston working engine, which was exhibited to Colbert, the French Minister of Finance. And so on, to Barber and others, until we come down to Street, who, on May 17th, 1794, made a great step in advance by using inflammable gas which was exploded in the cylinder and drove up a piston by its expansion, thus affording the first example of an internal combustion engine. The gas was obtained by sprinkling spirits of turpentine or petroleum at the bottom of a cylinder and evaporating by fire beneath. The up stroke of the piston admitted a certain quantity of air which mixed with the inflammable vapor. The flame was next sucked in from a light outside the cylinder through a valve uncovered by the piston and forced down the piston of a pump for raising water. In this engine many modern ideas were foreshadowed, especially the ignition by external flame and the admission of air by the suction of the piston during the up stroke; but the mechanical details were crude and imperfect.

From that time on a great many improvements were made which would be almost too tedious to mention in a paper of this length. Many of these were made by Lebon, Wright, Drake, Barsanti, Matteucci, and in 1860, when Lenoir and others took the matter up, gas engines had attained much greater importance. The matter was finally taken up by Sir William, then Dr. Siemens, who got up an engine on a regenerative plan. A few years later an engine was brought out by Kinder and Kinsey, which closely resembled the Lenoir, but presented no new features, and which consumed about 70.5 cubic feet of gas per horse power hour. The defect of most of the older engines was in the large consumption of gas in proportion to the work done.

Mr. Donkin, in his work on gas engines, says that in both the Lenoir and Hugon engines the pressures in the cylinder were always low and difficult to maintain, and this showed that the pressure generated by

the explosion alone was insufficient and must be increased by a previous compression of the charge. Time was also lost in obtaining an explosion, and the heat, applied too late to the gas, was speedily dissipated—some of it going to heat the jacket water and some being discharged at the exhaust.

M. Beau de Rochas, a French engineer, was the first to formulate a complete theory of the cycle of operations which ought to be carried out in a gas engine to utilize more completely the heat supplied. Four conditions were laid down by him as essential to efficiency:

1. The largest cylindrical volume, with the smallest circumferential surface.
2. Maximum speed of piston.
3. The greatest possible expansion.
4. Highest pressure at the beginning of expansion.

The construction of the gas engine was meanwhile developed in a different direction. As it was seen that the expansion of the engine was insufficient, an attempt was made to improve it by using a free piston, giving in theory unlimited expansion. 1863, Otto and Langen took out patents by which they proposed to construct an engine with the vertical cylinder open at the top, containing two pistons and piston rods, one above the other. By having the two pistons it was intended to break the force of the explosions, for the idea has not yet been abandoned that the shock was injurious to the efficiency of the engine. With the advent of the Otto gas engine a new era began. Until the appearance of this motor, in 1876, not one of the many engines produced had utilized the cycle of operations, indicated many years before as the best and most economical by Beau de Rochas. It is to Otto, the German engineer, that the honor belongs of having first produced a practical working gas engine, using compression and giving an economical cycle of operations.

The Otto engine was brought out at a time when, in the competition between gas and steam, the balance inclined so much in favor of steam that it seemed possible that gas engines would be driven altogether from the field. Few engines at that time were more ingeniously constructed than the Otto, and even now it is one of the most economical. More than 30,000 engines were sold in about 10 years, and over 35,000 engines, with a total capacity of 150,000 horse power, had, up to 1892, been constructed by them.

In a paper of this length it would be almost impossible to take up comprehensively the different types of English, French, German and American engines, but I have attempted in a way to give you a short history of the best known engines up to that period. But before closing this portion of the paper I would like to read you what Mr. Clerk says:

"From the considerations advanced, it will be seen that the cause of comparative efficiency of the modern type of gas engines over the old Lenoir and Hugon engine is to be summed up in one word, compression. Without compression before ignition an engine cannot be produced giving power economically and with small bulk. The mixture used may be diluted, air may be introduced in front of the gas and air, or an elaborate system of stratification may be adopted, but without compression no good effect will be produced. The proportion of gas to air in the modern gas engine is the same as was formerly used in the Lenoir, the time taken to ignite the mixture is the same, the only difference is compression. Combustion, or rather the rate of inflammation, is indeed quicker in the modern engine, because the volume of the mixture used at each stroke is greater, and yet the time taken to completely inflame the mixture is no more than the old type. The cause of the sustained pressure shown by the diagrams is not slow inflammation (or slow combustion, as it has been called), but the dissociation of the products of combustion and their gradual combination as the temperature falls, and combustion becomes possible. This takes place in any gas engine, whether using a dilute mixture or not, whether using pressure before ignition, and indeed it takes place to a greater extent in a strong explosive mixture than in a weak one.

"The modern gas engine does not use slow inflammation (or slow combustion, if the term be preferred), but in working, as it is intended to do, completely inflames its gaseous mixture under compression at the beginning of a stroke. By complete inflammation is meant the complete spread of the flame throughout the mass, not burning or combustion. If by some fault in the engine or igniting arrangement the inflammation is a gradual one, then the maximum pressure is attained at the wrong end of the cylinder, and great loss of power results.

"Compression is a great advance on the old system; the greater the pressure before ignition the more rapid will be the transformation of heat into work by a given movement of the piston after ignition, and consequently, the less will be the proportion of loss of heat through the sides of the cylinder. The amount of compression is, of course, limited by the practical consideration of strength to the engine and leakage of the piston, but it is certain that compression will be carried advantageously to a much greater extent than at present. The greatest loss in the gas engine is that of heat through the sides of the cylinder, and this is not astonishing when the high temperature of the flame in the cylinder is considered. In larger engines, using greater compression and greater expansion, it will be much reduced. As an engine increases in size the volume of gaseous mixture increases as the cube, while the surface exposed only increases as the square, so that the proportion of volume of gaseous mixture used to surface cooling is less the larger the engine becomes. Taking this into consideration it may be accepted as probable that an engine of about 50 indicated horse power could be made to work on 12 cubic feet of coal gas per indicated horse power per hour, or a duty of about 32 per cent."

The advance of the gas engine was much more rapid, and had come into more general use in Europe than in the United States, because, quoting from a paper[1] read before the American Gas Light Association, by Mr. Geo. G. Ramsdell, of Vincennes, Indiana, on October 14th, 1880, he speaks of the purchase of a 17-horse power engine of the Otto, silent type, which he describes as somewhat in the nature of an experiment, as no gas engine larger than 7-horse power had ever been used in this country. But since that time, within the last 10 years, the development of the gas engine has been enormous, and its rapid introduction for all sorts of purposes has been astonishing. When a gas engine of 100 horse power had been placed in actual use it seemed as though the limit had been reached for that particular engine, but now we know of engines of 650 horse power being in operation, and the Westinghouse people are constructing a 1,500-horse power engine.

During my recent visit to the East I very thoroughly inspected several engines of large horse power varying from 90 to 650, the latter of which is now in operation running a dynamo which is direct connected at the works of the Westinghouse factory in East Pittsburg, Pa. I do not see that I can give a better description of this engine than that printed in the *Gas Engine*, of April, 1900, written by Mr. Westinghouse, and which describes the operation of the engine as follows:

"Taking one cylinder of a three-cylinder gas engine as an example. When the piston is at the top of its stroke and begins to move downward it draws in a cylinder full of a mixture of gas and air. On the return stroke this charge is compressed into the clearance space between the top of the piston and the cylinder head. The piston having reached the top of its compression stroke, the charge is ignited by the spark formed by opening an electric circuit in the clearance space, causing an explosion, which drives the piston downward on its working stroke, the burnt gases being expelled through the exhaust on the return stroke, which, when completed, brings all the parts of the engine in position to repeat the same cycle of operations. The shaft which carries the exhaust valve is driven by gears from the main shaft. Each exhaust cam works against a roller carried on the free end of the guide lever. The exhaust valve has a long stem projecting downward and resting on a hardened steel plate on the upper side of the guide lever. The spring surrounding the stem serves to hold the exhaust valve to its seat and the stem in contact with the guide lever. From the exhaust cam shaft a horizontal shaft with beveled gears leads to the opposite side of the engine engaging with a vertical shaft, which in turn drives the upper cam shaft. Incidentally the vertical shaft carries the governor. The upper cam shaft carries two cams, for each cylinder one engages against a roller on the end of the horizontal lever. As the throw side of this cam comes uppermost, the opposite end of the lever depresses the stem of the inlet valve, opening the latter for the admission of the mixture of gas and air. A spring on the stem of the inlet valve furnishes a means for closing it and keeping the cam and roller always in contact with each other. Immediately adjacent to the inlet valve cam is the igniter cam, which at the proper instant operates a horizontal plunger working through the guide to break the electric current through the wire at the terminal of the igniter.

"The cylinder heads and the upper end of the cylinder are thoroughly water jacketed, as, owing to the extreme heat to which these parts are subjected, they would soon become red hot if no means were provided to keep the temperature down.

"The gas and air enter the mixing valve chamber by separate inlets, in proportionate amounts, which can be fixed by the attendant, and the mixture is conducted through a distributing chamber to the port lead-

1. See JOURNAL, Dec. 2, 1880, p. 245.

ing to the cylinder head in which is the inlet valve. To make a complete cycle the following are the four steps:

"1. *Induction.*—The piston is on its downward stroke, the inlet valve is open and the charge of gas and air is being drawn into the cylinder. The exhaust valve is closed and the inlet valve will close just as the piston reaches the limit of its downward stroke.

"2. *Compression.*—The piston is on its upward stroke; both valves are closed and the charge of gas and air is being compressed into the clearance space.

"3. *Ignition and Expansion.*—The piston has reached the upward limit of its compression stroke, the crank is just passing its upper center and both valves are still closed. Shortly before this the igniter cam has brought the igniter terminals in contact, completing an electric circuit. Just at this instant it releases them, and they fly apart, actuated by a coiled spring in the guide breaking the circuit and forming a spark which ignites the charge. An immediate rise of pressure occurs and the piston is forced downward by the expansion of the burnt gases, both valves remaining closed until just before the completion of the stroke when the exhaust valve opens.

"4. *Exhaust.*—The piston is ascending, forcing out the spent gases through the now open exhaust valve and the exhaust pipe. The exhaust valve closes as the piston completes the stroke, bringing everything in readiness to repeat the cycle.

"The Westinghouse gas engine claims to have no competitor in regulation. The frequency of the impulse of the Westinghouse gas engine is the same for all loads, and the relative proportions of gas and air remain constant, but the amount of the charge admitted to the cylinder and the consequent strength of the impulse are graduated exactly to the power required. By this system is obtained a nicety of regulation that is equalled only by the best types of automatic steam engines. The regulation of the Westinghouse engine is such that an engine direct connected to a dynamo will supply intermittent power for elevator service, and at the same time furnish an electric lighting system with perfect steadiness, and, what is perhaps still more exacting, run alternating current dynamos in multiple.

"The governing apparatus makes it possible to determine accurately the best proportions of gas and air to be used. At the top and bottom of the mixing valve chamber are horizontally moving levers with pointers swinging over graduated arcs. The upper lever controls the gas supply and the lower one the air supply. The ratio between the readings on the two scales, with the levers in any fixed position, shows exactly the proportion of air and gas in the mixture supplied to the cylinders. When the engine is running on a steady load, if one mixing-valve lever is moved backward and forward while the other remains stationary, the regulating valve stem will be seen to move up or down as the mixture becomes less or more efficient, indicating that a greater or less quantity is being used.

"An automatic starter is used in connection with Westinghouse gas engines. It consists of a small air compressor driven by the engine, which forces air into iron tanks, maintaining a supply which is kept in readiness for starting at any time. Three or four revolutions with the air pressure are sufficient for starting. The entire operation is strictly automatic and can be accomplished by one attendant without assistance."

We have in San Francisco a company called the Union Gas Engine Company, which is manufacturing gas engines on a large scale, but on a little different principle. They make engines having three, four or five cylinders, as the necessities of the case require, each cylinder being independent of the other, and can be shut off as the occasion may require. This system seems to meet with the approval of Mr. E. W. Roberts, M. E, who, in a paper on gas engine economy written for the *Gas Engine*, says:

"It is not realized by every gas engine manufacturer that the advantages of the multiple cylinder are numerous. In the first place, an increase in the number of cylinders is conducive to steady running, as is generally admitted. The decrease in the necessary weight of the fly-wheel is not only of advantage in the saving of iron, but it also reduces the friction of the engine to a marked degree, and consequently increases the mechanical efficiency of the engine. In a multiple cylinder engine there are opportunities for balancing which are lost sight of by the majority of designers, and much has been done in this line in a hit-and-miss sort of a way. There is much literature on the subject of balancing, and very few writers agree as to proper methods. In fact, the gas engine builder quite frequently has derived an empirical formula of his own which gives results that are, in his estimation, good enough, but by no means perfect.

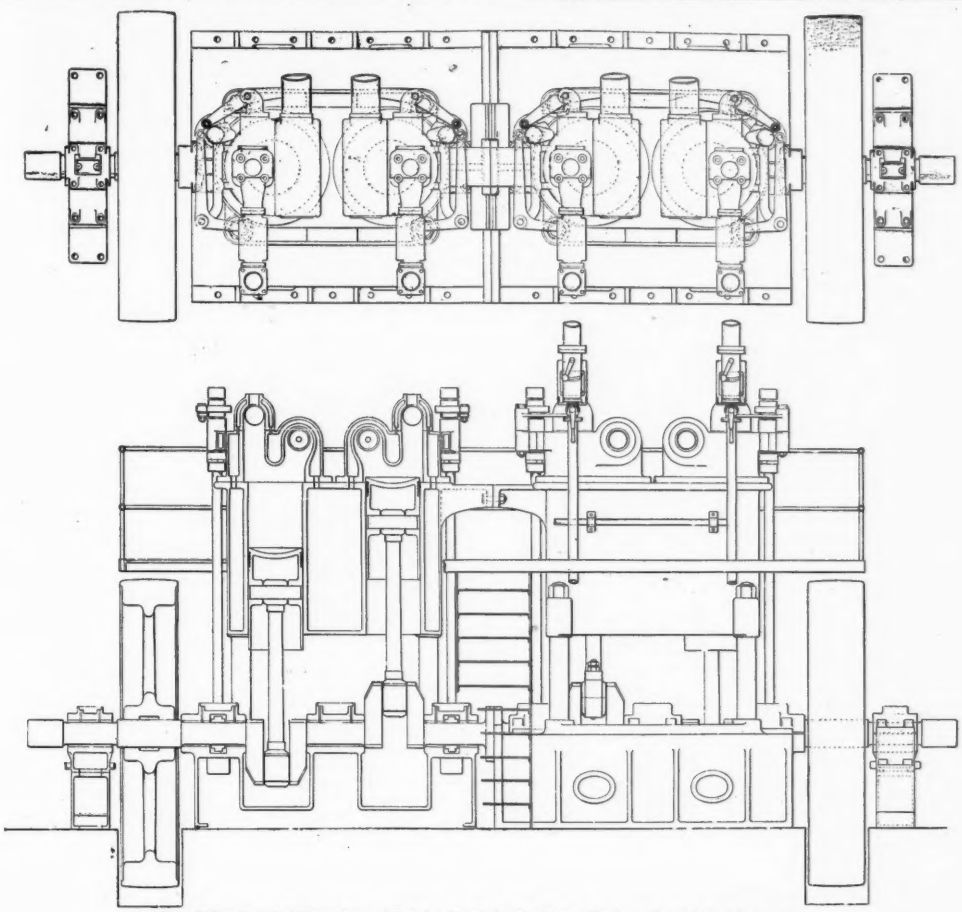
"There is also a chance for improvement in the handling of the water that passes through the water jacket. In factory tests it has been found that the best results were obtainable when the temperature of the water leaving the water jacket was 150° F., this temperature varying in different engines. But the writer has yet to see a single gas engine construction sheet in which this fact is mentioned. In fact, no attention whatever is paid to the temperature of the water jacket after the engine leaves the factory. Now, why should this be? Is it because the engine is the motive power for the ignorant or the indolent? The writer admits that this matter does not assume great proportions in the engines of small dimensions; but the question arises: 'Would it not pay to employ a temperature regulator on the engine that would control the temperature of the engine cylinder by means of the water supply?' It would be absolutely useless to leave this regulation to the engineer unless the engine were operating under a comparatively constant load, for with a diminution of the load the water supply should be decreased, and vice versa."

In these notes which I have collected I have as far as possible taken the history and experience of other people. In making a personal investigation recently of the gas engine my primary object was to ascertain, if possible, whether our Company would be justified in displacing the steam engines which we have at present in use, and which are now running our dynamos at the electric station known as station C, and which aggregate about 3,500 horse power. During the investigation I found that the engine of 650 brake horse power, running the Westinghouse shops with a direct connected dynamo, was running on from 12 to 14 feet of natural gas, which contains 1,000 B.T.U. One of the most important things for us to ascertain in this connection was whether illuminating gas containing from 635 to 700 B.T.U. would give the same results, using approximately the same amount of gas. This question apparently was not understood at first. At Long Branch, N. J., the Westinghouse people had put in a 280-horse power engine, which was operating with a gas of about 650 B.T.U., and which operated a belt-connected dynamo for their electric station. In figuring the diameter of the cylinder sufficient allowance was not made for the difference in the heat units and considerable trouble was experienced from that cause. But in a short time this was overcome, and at present the engine is running in a most satisfactory manner. I stood for a long time watching the regulation of this engine and found that it ran on a light load almost as well as on a full load, as far as regulation was concerned, the only apparent difficulty being that the engine back-fired with a loud report once or twice, but did absolutely no damage. The noise from the exhaust had been muffled so that it was not objectionable in the least degree, and the amount of gas consumed was from 18½ to 19 cubic feet per horse power hour.

In the office building of the United Gas Improvement Company there are also two gas engines of 90 horse power each direct connected to dynamos which run the elevators and also furnish light for the building, and I am told that their operation is very satisfactory, and that their regulation is so complete that the running of the elevators at the same time with the lights does not seem to make any material difference. The consumption of gas by these engines is about 18½ cubic feet per horse power hour; but the largest and best of all the engines was the 650-horse power engine at East Pittsburg, which impressed me very much with its steadiness and the silent manner in which it ran.

The Union Gas Engine Company, of San Francisco, has never built an engine larger than 150-horse power, but it seems to me that the principle of the engine is good as well as the workmanship and they have shown great intelligence in the handling of it. So, being a local Company, I have given it a chance to build a 300 horse power engine with 4 cylinders. This engine is to be direct connected to a 200 k.w. generator, running at a speed of 200 revolutions per minute.

I am satisfied in my own mind that, with the great improvement made in the gas engine, it will finally supersede all other types of engines which are used for purposes of this sort. With a consumption of gas not to exceed 20 cubic feet of gas per horse power hour, with a regulation guaranteed within 2½ per cent., and the ease and economy with which the gas engine can be started or shut off at a moment's notice, and the saving in cost of attendance, I do not see how any other engine known at the present time can compete with it. In addition to that, even in other places, such as mining camps and factories where there is no gas manufactured for illuminating purposes, a cheap fuel can be made, either by the Dowson or the Loomis process, which is adapted for the use of these engines, and although these fuel gases contain only about 150 heat units as against 650 in ordinary illuminating gas, thus requiring from 4 to 5 times the amount of gas, they can be manufactured so cheaply that in the long run it may be better to use



Plan and Elevation of 300-Horse Power 4-Cylinder Gas Engine for the San Francisco Gas and Electric Company.

them where circumstances warrant than to use the regular illuminating gas. A great many engines using Lomis fuel gas are in operation in the mines of Arizona, New Mexico and Mexico, and according to all the reports from these places are giving eminent satisfaction.

Therefore, in conslusion, I would say, from what I have seen and know, that if I intended to install a new plant for operating electrical dynamos, hoisting works or anything of that sort which required an engine within the range of the present development, I should not hesitate a moment to put in a gas engine.

Discussion.

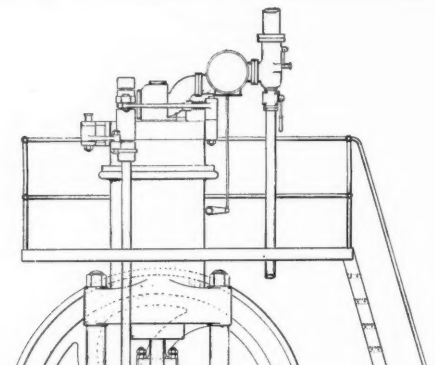
The President—The paper of Mr. Crockett is certainly of great interest. As these papers are read for the purpose of enlightening you on various subjects, free discussion should be indulged in. We would like to hear from anyone who may have a word to say. The author of a paper feels better satisfied if there is some discussion, whether pro or con.

Mr. Lowe—Mr. Crockett has just told you that the Union Gas Engine Company, of this city, is building a 300 horse power gas engine for the San Francisco Gas and Electric Company. A Mr. Casey, one of the members who joined the Association at this meeting, is the President of the Union Gas Engine Company, he can undoubtedly give us valuable information on this point.

Mr. Casey—There is really little to say after the exhaustive paper by Mr. Crockett, as he has completely described all the functions of each part. About all that I can say is that this engine is a slight departure from the usual construction in that it is a four-cylinder, vertical engine. Each cylinder is a separate engine and can be disconnected at any time for repairs to one of the cylinders, if necessary, or for the purpose of saving fuel in the event of reducing the load. Each cylinder has its own separate governor. The four-cylinder engine is really two double cylinder engines bolted together. The crank-shaft is divided in the center and connected by flanged couplings in the same manner as in large marine engines. The bases of the frames are separate and are bolted together. The object of this construction is that, in the event of wanting to run generators from both sides of the machine, probably at different speeds, it can be accomplished by simply taking out the bolts from the couplings. The governors are placed on top of the engine and stand vertically in order to make them very sensitive. The valves are balanced by a balance placed on the horizontal shaft that works them. The governor is above it. It is a double-valve governor, and graduates the charge in proportion to the amount of energy needed. Gas is brought in from the top and air from the bottom. Each has its own regulator or governor. Inlet and exhaust valves are separate. Both are on top of the engine, as are all the working parts that need attention. By having four cylinders we have an impulse on every half revolution, just as in the case of a double action steam engine. There are no loose joints. Everything is regulated when the engine is first set up. It is so regulated that the cylinders will fire regularly, no two of them at the same time.

Mr. L. P. Lowe—What is the speed of the engine?

Mr. Casey—The normal speed would be 200 revolutions per minute. There are two fly-wheels, 8 feet in diameter, weighing 6½ tons each. We expect the regulation to be within 1½ per cent., and the consump-



tion to be about 16 or 17 feet per horse power hour, when running at full load. Another feature is that there is no residue left in the engine after each explosion. In our old type of engines there was always a residue left in the head of the engine, so that when the piston went down it mixed with the fresh charge the burned products that had not been expelled from the last charge. Now each charge will be purely a fresh mixture. The gross weight will be about 80,000 pounds. It is about 24 feet long. It starts, as Mr. Crockett has told you, by simply opening a lever. The shaft is 7 inches in diameter in the bearings, and 8 inches when it goes through the fly-wheel. The stroke is 22 inches. The connecting rod brasses are of the same type as in marine engines. The cylinders are united at the top by a flange and bolted together so as to keep them rigid.

Mr. Valentine—Can you run them as two engines?

Mr. Casey—Yes; you can disconnect them in the center at the coupling and run either engine separately.

Mr. Valentine—Would that necessitate the shutting down of the engine?

Mr. Casey—Yes; you would have to shut the engines down to disconnect them. These bolts are driven in with a sledge, and in addition there is a key going through both sides of the coupling. However, it is only a matter of half an hour or so to do the work.

Mr. Aldrich—I would like to ask the consumption of gas per hour when the engine is running empty.

Mr. Casey—I do not really know what that would be. There would probably be a little more friction than in the case of a single cylinder engine of the same horse power. We will know definitely about that in the course of a few months.

Mr. Aldrich—I presume that in a smaller engine friction might be something of an item.

Mr. Casey—The loss by internal friction is something that cannot be entirely overcome. It can only be reduced by more nearly perfect construction.

Mr. L. P. Lowe—I want to say that the San Francisco Gas and Electric Company is to be congratulated on the step it has taken in introducing gas engines for running its electric light plant. I have travelled up and down this Coast pretty thoroughly, and in fact over the entire United States, and I believe that gas companies do not pay sufficient attention to the gas engine. We all know there are very few gas engines in use. The electricians have gotten away with us. But now that large unit gas engines have been developed the companies are taking them up; and well they may. It seems to me that if they would stop to figure out the actual cost of running a gas engine they would find that no other power in the world can approach it. In order to operate a gas engine it is necessary to increase the operating expenses of a gas plant only by the cost of the material actually used. It is not a question of the cost of the total amount of gas in the holder; it is merely a question of small additional amount of material put into the gas making apparatus to make enough gas to drive a gas engine. If gas companies would look at the matter in this light they would find that they have at their own doors the cheapest possible power, not excepting water power; for under ordinary conditions the investment necessary for an electric water power installation entails heavy interest charges, while the fixed charges of a gas works would not be increased by the manufacture of additional gas for fuel purposes.

Mr. Crockett—I have some tests which were made on the larger types of engines, showing the differences in efficiency under different loads: Full load, 18.3 cubic feet per horse power hour; 77 per cent. load, 18.6 cubic feet per horse power hour; 54 per cent. load, 21.9 cubic feet per horse power hour; 50 per cent. load, 26.5 cubic feet per horse power hour.

Mr. Osborn—In our water power plant at Marysville we are running at less than one-half load three-quarters of the time. Our peak load is from 7 to 9 oclock, P.M., and from midnight to morning we are running with about 25 per cent. load. I believe the Santa Cruz Gas Company was the pioneer on this Coast in experimenting with gas engines for running dynamos. They used a 2-cylinder Otto engine. It would run perfectly on a constant load, but when the load began to drop the engine would miss an explosion, the fly wheel would not keep up the speed until it could get another explosion, and there was a great fluctuation in the lights. I do not know what amount of gas was consumed. This engine with a constant load would appear to do away with that difficulty, but if it was made a double engine it would appear to be open to the same objection as the Otto engine.

Mr. Crockett—Don't you have the same trouble whether you are running with a steam engine or a gas engine. When you are running with a steam engine and the load drops you are wasting power. With gas you can use engines of different sizes and types. Run one and shut the other down. They are so easily started and shut down that you can use engines of different sizes and capacities. Of course in a small works that would be harder to do.

Mr. Gregory—In Stockton they have two 200-horse power gas engines running on the street lights and on the street car system. I understand they have been an entire success. When they are running you can scarcely see any difference when the power line is cut off.

Mr. Osborn—I might add that the engine used at Santa Cruz was afterwards taken by the Stockton Company. The fact that they added another engine of a similar type proves that they consider the engines a success. They are run on a railroad generator, where the load goes from peak to nothing in a minute, and the regulation must be very much better than at Santa Cruz.

Mr. L. P. Lowe—The Lowe railway was operated on gas engine power. They had two 60-horse power Otto engines and one 120-horse power. They worked quite satisfactorily, and I cannot imagine any service that would be as intermittent as running a street railway line. They were run for a number of years until cheaper electric power was brought in from the mountains.

On motion of Mr. E. P. Callender a vote of thanks was extended to Mr. Cockett for his able paper.

Committee to Nominate Officers.

On motion of Mr. Crockett the President was authorized to appoint a committee of three to nominate officers for the ensuing year. He named as such committee Messrs. C. F. Adams, L. P. Lowe and T. R. Parker.

Report of Committee on President's Address.

The President called Mr. Crockett to the Chair and the Secretary read the following report of the Committee on the President's address:

The committee appointed on President's address beg to report as follows:

We congratulate the Association on the ability displayed by the President in his address, showing as it did the gigantic strides made in the gas industry.

We recognize the great importance of the Gas Congress to be held at the Paris Exposition during September, and heartily support his suggestion that a representative of the Pacific Coast Gas Association be sent, and that his report be made a special paper at our next annual meeting.

We recommend that a committee of three be appointed to draw up suitable resolutions on the death of the late Mr. D. E. Knight, and

that the same be inscribed on the records of the Association, and a copy sent to the relatives of the deceased. W. A. ALDRICH, C. E. BURROWS, M. C. OSBORN, } Committee.

On motion of Mr. Jones the report was accepted and placed on file.

NAMING A REPRESENTATIVE AT THE GAS CONGRESS.

Mr. Jones—Following the recommendation of the committee's report I would like to say that our Secretary, Mr. Grimwood, is about to leave for Europe. He will be in Paris during the International Congress of gas men, and I move that he be named the official representative of the Pacific Coast Gas Association to visit the International Congress and report to us at our next meeting. [Carried.]

The President—I assure you, gentlemen, it is a great pleasure for me to hear this resolution passed, and to know that Mr. Grimwood will be able to go. When I made the suggestion I had no idea that he would be in Paris.

Mr. Grimwood—While I appreciate the honor very highly, I think that perhaps the resolution might be placed on broader lines. Others of our members might be going to Paris and might be appointed as a committee to represent the Association. I think it would be well to make some inquiries into the matter. If no one else is going I shall of course take great pleasure in representing the Association to the best of my ability.

Mr. Osborn—The committee in thinking over this matter, of course, had Mr. Grimwood in mind. We did not think that there was anyone more capable than Mr. Grimwood of representing us at the Congress and telling us what he saw.

Mr. Burrows—I move that the incoming President be authorized, if he hears of any other member who is going to Paris, to appoint him as an associate of Mr. Grimwood to represent the Association. [Carried.]

The President then introduced Dr. R. M. Powers, of San Diego, Cal., who read the following paper on

THE USE OF CRUDE PETROLEUM FOR FIRING BENCHES.

In these days of keen competition it is absolutely necessary to take into consideration all the items of expense attending the production of any article or commodity for general use. In its broadest sense we accept the truism that "economy is wealth," but in the case of the gas manager it may mean diminished expenses on the one hand or a greater profit on the other, as I assume that few if any of us are amassing wealth with alarming rapidity at the present time. The gas manager must be vigilant and watchful in every department of his business, from the purchase of material to the distribution and sale of his product. It is especially necessary at the present time, as it seems to be the aim of nearly all of the gas companies of the country to very courteously accede to the demands of the public for cheaper gas. The mania has taken possession of us on this Coast, and reduction has followed reduction until we find that, while we are getting less than 50 per cent. of the former prices we are paying from 50 to 100 per cent. more for everything that enters into the manufacture and distribution of gas. It is evident that as long as we cannot raise our price to meet existing conditions, we must exercise the closest economy in order to make any profit, or at least to prevent the sacrifice of our property. I have endeavored to present for your consideration on the above lines, and in a brief manner, the result of our experience in using oil for firing benches in our retort house. Owing to limited time I have not given the subject all the attention it deserves, s ill I have sufficient data upon which to base a reasonable conclusion. My attention was attracted to the use of crude oil about three years ago as a means of keeping up the heat in our benches during the tedious and exasperating process of "clinkering." At my suggestion our Superintendent, Mr. R. L. Clarke, who was then the engineer of our electric light plant, placed an oil burner under one of the benches with the result that the stokers could clinker at their leisure without loss of heat and a poor yield as had been the case formerly. Mr. Clarke insisted that he could save money for the Company if I should permit him to use oil exclusively, but the proposition was so unusual that I could not at first accede to it. As a matter of course the retort men favored it, as it materially diminished their labor in firing, clinkering, removing ashes, etc. As a result of the experiment I am satisfied that we have saved money by the use of oil.

Herewith is submitted a test continued for three months with coke, tar and crude oil on two benches of 6's, Weber half-depth regenerative furnaces. The output and conditions were practically the same for the three months. During one month we used 134,220 lbs. of Wallsend coke, in the next month we used 7,680 gallons of tar, and the third month we used 8,745 gallons of oil. The oil cost us $1.47 per barrel, or 3½ cents per gallon, in our storage tank. 8,745 gallons of oil equalled 7,680 gallons tar, equalled 134,220 lbs., or 67.11 tons, of coke.

8,745 gallons oil equal or cost $306.075 equals 3½ cents per gallon.
7,680 " tar worth for fuel " " " 3.99 " " "

67.11 tons of coke has a fuel value of $4.56 per ton.

For steam purposes we have obtained practically the same results, the relative value of our fuel under our boilers being, oil 3½ cents; tar, 4.2 cents; coke, $4.66 per ton; and Nanaimo coal, $5.88 per ton. Last season we operated our water gas plant and commenced by using what was billed to us as "Washed Sopris" coke, costing us $11.35 per ton. We next used Cerrillos anthracite, costing in our yard $10.85 per ton. We got better results from the anthracite, but owing to delay in receiving shipments we were compelled to use our gas coke with the following results: Taking Cerrillos anthracite at $10.85 per ton as a basis, the Sopris coke had a relative value of only $8.72 per ton, while our Wallsend and Greta coke was relatively worth $9.04 per ton. It is evident from the foregoing that we cannot afford to burn coke under our benches with a fuel value of $4 56 per ton, while in our generator it has a relative value of $9.04; neither can we afford to pay $8.55, which is the present price of Nanaimo coal, for steam purposes, while it has a relative value of only $5.88 as compared with oil at 3½ cents per gallon, and tar at 4.2 cents. The inference, therefore, is that the company making coal gas can afford to use oil at $1.50 per barrel, and sell its coke to the company making water gas exclusively, and the water gas company can afford to pay a net price of $9 per ton for gas house coke in comparison with other fuel. These figures will of course vary with existing conditions, but will serve as a basis for calculation. In many sections of the State the specific gravity of crude oil ranges from 11 to 16°, and the heavy oil can doubtless be purchased at a less figure than oil of 16 gravity and upwards. Our method of using crude oil is described by our Superintendent, Mr. Clarke, as follows: "The burner is placed near the grates and throws a fan-shaped flame up through the furnace, equally heating all the bridges, and not so intense on a few of the back ones as in the former arrangement. The fan-shaped flame in the furnace creates a proper circulation of the hot gases around the retorts, being up in the center and down on the sides to the flues. This serves to keep an even heat in the retorts up to the necks and incidentally serves to make the stoker 'hot in the collar.'" The burner in use in our works was devised by Mr. Clarke, and a sketch with description has been sent to Mr. Hollidge of the Wrinkle Department.

Aside from the actual saving to be derived from the use of crude oil for firing benches, the additional arguments which every salesman and superintendent employ when urging the use of gas for fuel are: It is always under control; it is clean, comparatively economical and in every way satisfactory, with no clinker or dirt or ashes to accumulate; but more than all, it meets that most desired of all requirements of the gas manager—economy.

Discussion.

The President—This interesting paper on the employment of oil as a fuel under benches is now open for discussion. I believe Mr. Thompson, of Woodlands, has used oil.

Mr. Thompson—We have used an oil burner for making steam and found that it worked very well. There is no shoveling of coke and no clinkering. Regarding the saving, Mr. Joslyn, who is here, will be able to tell you what has been accomplished.

Mr. Parker—What is the consumption of oil per hour?

Mr. Thompson—I have not the exact data, but is in the neighborhood of 6 to 8 gallons.

Mr. Jones—The question of fuels in gas works becomes more and more important every day. In many California places oil is becoming plentiful and cheap and coke is maintained at a high price. Coke is used for many purposes for which it cannot be displaced by any other fuel. Going about the country I find many small works use coke for firing the benches, where the proprietors are getting a low price for tar, and oil may be bought at a low price. At our stations in San Francisco we make a careful study as to the cheapest fuel. Recently we have been burning tar, and at the same time firing boilers with injected oil tar without taking from it any of the water mechanically held in solution. I find that with coke at $7 a ton in the yard coal tar is worth $2.15 a barrel to burn under the benches. We find we can run a bench of 6's with 95 gallons of coal tar for 24 hours. I think the same figures would apply to the use of the heavier California oils, such as the Los Angeles crude.

Dr. Powers—We found after careful tests that it paid us better to use

our tar for fuel purposes than to sell it at the prevailing prices. The tar is worth $2 a barrel to us in comparison with coal at $5 88 per ton.

Mr. Joslyn—It seems to me the information I might give would not be of great benefit to you, as many of our members having large plants are so situated that they can make perfect tests; but on the principle that any experience is worth something, I will state, in the first place, that we were using Castle Gate coal, costing us $6.75 per short ton laid down at our depot, with 50 cents additional for hauling. In October of last year the price was raised to $10.12½, or $10.62½ laid down in our works. At that time I purchased a Wilgus burner, put it under our 17-horse power boiler, and for 60 days compared it with the previous 60 days' run. We found that our oil cost us only $7.35, as against coal at $10.25, to accomplish like results. In a large works where a separate fireman would be required to handle coal his wages could be saved in addition, as anyone about a gas works can attend to the adjusting of the oil burners. We have had no trouble with their filling up; nothing like what we would have had with coal. At the present time coal is down to $8.45 per ton, and yet we find a saving in oil.

Mr. Lowe—What kind of oil do you use?

Mr. Joslyn—Coalinga oil, costing us 4½ cents per gallon.

Mr. Osborn—In Marysville we use oil beneath our water gas boiler. The records last month show 1.3 gallons of oil per 1,000 feet of gas manufactured. This includes blowing-up steam in the morning and then balancing our set, which takes about 1½ hours before we make gas. If we were making gas continuously the cost would be less than one-half of that amount in our size of set. Of course the size of the set regulates the cost.

The President—As your works are new, possibly you have always used oil since they were first constructed.

Mr. Osborn—Almost entirely. I have used some wood, because I fell heir to some. I find that wood at $3 per cord is about a stand-off.

Mr. Parker—Perhaps a little addition to the foregoing information might be acceptable. While we were running a bench of five's at Napa we used tar and also oil in order to generate heat. Our retorts are a little larger than the ordinary run. We work off a ton of coal in five hours. We used 3 gallons of oil to work off the coke in good shape. Our benches are of the regenerative type. Dr. Powers said he introduced the oil burners within six inches of the grate bars. We introduced the tar about three feet above the grate bars, and by the regulation of the secondary air we had an intense glow. We could get a heat sufficient to melt the bench down simply by working the dampers.

Dr. Powers—We succeeded in burning our works down. (Laughter.)

Mr. Osborn—It is certainly gratifying to know that we are progressing. In 1893 the statement was made that a member, in endeavoring to fire tar under his benches, was forced to discontinue it because the smoke came down and put out the eyes of the stoker.

Mr. Joslyn—I would like to state one fact with the idea of getting some information. We did not change our furnaces at all when we began using oil. We simply inserted our burner about a foot away from the grate bars and turned on the oil. We have never made any change. We could put in coal any day and leave our burner as it is. I would like to know if we could get better results by covering over the grate bars with brick, or whether they should be left as they are.

Dr. Powers—When we took over the old San Diego electric light plant we found the boilers in bad shape from burning oil, and the conclusion we arrived at was that it was dangerous to get the full heat on immediately; that it was dangerous to the furnace walls and to the boilers to let them cool off suddenly. We covered our grate bars, took all of our coke breeze, and fed it under our boilers. We slowly ignited that, and when we shut off our oil we had a fine bed of fuel that preserved the heat. In this way we economized. We use less oil than if we were using oil alone. It is a clear saving to make use of it in this way.

Mr. Jones—In using oil for boiler firing we find that by providing some sort of a checker-brick work on the grate bars as a heat arrester we effect considerable saving. The fact that there is no glowing body of fuel to radiate the heat causes a fleeing of the heat. It is apt to get away from the boiler setting too rapidly. If it is arrested by some baffle work the baffle work acts as a radiator of the heat and better results are obtained.

Mr. Joslyn—What kind of a burner did you use, Mr. Jones?

Mr. Jones—The Larkin oil burner.

Mr. L. P. Lowe—Almost every boiler in Southern California is fired with crude oil, and the common practice there is to cover the grate bars with firebrick, and also, as Mr. Jones explains, to place some brick so as to baffle the flame.

Mr. Joslyn—We used a little debris at our works; we don't have much to use. When we start our fire we have to put in a little wood, or possibly 10 to 15 pounds of coal. That leaves a little clinker over our grate bars, perhaps an inch deep.

Mr. L. P. Lowe—Do you have any steam on your boilers in the morning?

Mr. Joslyn—Sometimes we do, and sometimes not. We quite often have 5 or 6 pounds.

Mr. L. P. Lowe—If you have a good oil burner you can use waste to light it.

Mr. Osborn—It is best to start just before the steam gets down, because if you have to draw the fire you have left you have to break the clinker and lose the coal that is in the clinker. I find that you cannot use half coal and half oil.

The President—I would like to ask Mr. Gregory if he has not had some experience.

Mr. Gregory—My experience would seem to be the opposite of Mr. Osborn's, when he says you cannot use coal and oil together. We take coke breeze or any old fuel that we cannot get rid of, put it on the grate bars and start up the fire. Then we start the tar burner going. We do not expend any extra labor at all. We have a door with an opening and set the oil burner at the top of the door so as to shut it in about a foot above the grate bars. This was calculated to fire the oil right on the coke and tar. It is possible to keep the fire going a long time using nearly all tar. A little coke will go a long way. This method avoids turning the blazing tar against the boilers.

Mr. Hollidge—Do I understand that it is necessary to construct a checker-brick work on top of the grate bars?

Mr. L. P. Lowe—If you put the flame in in the ordinary way a large amount of heat would escape up the stack. By this method the heat is given off slowly by radiation. There is no question about it giving better results. Probably the greatest efficiency in the use of oil is attained on the Santa Fe locomotives, the fire boxes of which are bricked in a peculiar way. The oil is injected underneath an arch, and doubled back.

Mr. Joslyn—I would like to ask if it is necessary to use a pump in order to maintain a perfect pressure? We use pressure by gravity.

Mr. L. P. Lowe—You can get a regulator pump at a cost of about $10 that would give a constant pressure on your oil burner. There is a satisfactory regulator on the market, and I think it the best thing to use in connection with a burner of that description.

Mr. Joslyn—I have recently seen a large traction engine of 60-horse power operated by oil instead of by coal—something I believe that has not been tried before. I understand the results were entirely satisfactory.

Mr. L. P. Lowe—Were any peculiar methods used on account of its being a traction engine?

Mr. Joslyn—No; nothing specially worthy of mention, except that it showed the possibility of carrying oil and feeding it in a proper manner.

Mr. L. P. Lowe—The method applied by railroad companies is to take air from the air brake pump and drive the oil out in that manner. It requires an air compressor to do it. That keeps the oil entirely from the flame.

Mr. Hollidge—While in Fresno I examined the methods followed there in one of the hotels where oil was used under one of the boilers. Instead of having a pump directly connected with the oil they had two tanks elevated about a foot over the height of the oil burner inside. Each tank is connected underneath with the city water. They fill the tanks with oil, turn on the water from underneath, and the water presses up the oil as the injector uses it. When the tanks are empty they turn on a faucet, let the water run out, fill them with oil, and turn the water on again.

Mr. Lowe—That method has been in use for a great many years. It was formerly used on water gas tanks in the East. I think, however, the most satisfactory method is direct through a pump governed by a pressure regulator to maintain a constant pressure. It is not expensive and is perfectly satisfactory.

On motion of Mr. Parker a vote of thanks was passed to Dr. Powers for his valuable paper.

[To be Continued.]

THE proprietors of the California Light and Heat Company will construct a gas works at Santa Clara, Cal. The plant under the construction contract, which we understand has already been awarded, must be completed by November 19th. It is specified that the minimum capacity of the plant shall be 60,000 cubic feet per day.

Natural Gas as an Important Trade Factor in the Pittsburg District.

Mr. J. C. McDowell, writing about the importance of natural gas as a contributor to the wealth of Pittsburg, Pa., says:

The first introduction of natural gas into the Pittsburg district was by Spang, Chalfant & Company, who laid a 5⅛ line from wells near Millerstown, Pa., to their mill at Etna, where it has been in almost constant use since.

In 1882 the Penn Fuel Gas Company, organized by Messrs. Pew and Emerson, constructed a gas line of 5⅛ and 6-inch pipe from the Murraysville field to Pittsburg, where the gas was turned into the gasometer of the illuminating gas company, and an attempt made to utilize it as an illuminant, but this was soon abandoned, owing to its poor qualities as an illuminant.

In May, 1883, it began to be used as a domestic fuel, the very first to use it being Captain Seeley, in his real estate office at the corner of Penn and Highland avenues. It was next introduced into the residence of Judge Miller, and was soon quite generally used.

In 1883, Mr. Sellers McKee, Dr. Hostetter and Robert Brown organized the Fuel Gas Company, and laid two 5⅛ lines, the twin lines to Pittsburg from the Murraysville field. Both of these companies were organized under the act of Legislature authorizing illuminating companies, and their charters were declared invalid by the courts. In 1885 the Legislature passed the natural gas act, the Peoples Natural Gas Company being granted the first charter under the act.

In the fall of 1884, Mr. George Westinghouse drilled a well in the city in his own backyard, and from it began the business that developed into the Philadelphia Company, and guided by the business tact and energy of Mr. Westinghouse and his associates, it steadily increased in importance until, in the early part of this year, when Mr. Westinghouse sold his holdings in the company and relinquished its management, it was by far the largest company engaged in the natural gas business.

From the small beginnings of a short time ago the business has assumed immense proportions. The combined capital of the companies now engaged in the business in the Pittsburg district aggregates about $40,000,000, operating 2,500 miles of lines and 1,200 wells, employing 2,500 men, and holding under lease over 40,000 acres of land for which they pay as rents and royalties to the farmers annually $500,000. At this writing the daily consumption of gas in the district is approximately 110,000,000 cubic feet, equivalent to 6,000 tons of coal. In the winter season the consumption is at least 30 per cent. more than at present, and to maintain this production over 300 wells are drilled annually. This gas is used by over 500 different mills and factories and 40,000 families. Many millions of dollars of Pittsburg capital are also invested in the business in other sections.

The centers of production are Murraysville—its palmy days 14 years removed—having at present about 100 producing wells, low in pressure, but yielding 10,000,000 or 11,000,000 feet per day. Canonsburg, Hickory and the Moon township fields are still furnishing a goodly supply, while nearly every township in Allegheny county, north of the rivers, and in Southern and Southeastern Butler county has within its borders several good producers and territory with a rock pressure that warrants drilling new wells.

Armstrong county probably contains the largest area of developed gas territory of any county in Pennsylvania, fully 150,000 acres being under lease. The rock pressure is still comparatively high throughout the entire field, and there are many thousand acres of reasonably sure territory yet untoched. A number of new wells have been completed this summer, with a capacity of from 3,000,000 to 5,000,000 cubic feet daily, and a rock pressure of from 400 to 600 pounds to the square inch, and the Philadelphia Company recently completed a well of more than 5,000,000 feet daily capacity in a lower sand than anything heretofore drilled in the vicinity (the fifth sand), with a rock pressure of 850 pounds. From Bellevernon, southwest through Greene county, there are many good pools and large acreage under lease, tributary to the Pittsburg district.

The West Virginia field is a vast one, already developed for over 30 miles in length, under which gas is found in five different prolific horizons, or sands. The lowest, the fifth sand, seems to be the most universal. Its rock pressure is the highest ever discovered, being in some wells 1,300 pounds to the square inch, while the volume of the wells is phenomenal, several wells sunk to the horizon showing a volume of fully 25,000,000 feet per 24 hours. All of the developed territory is under lease to strong companies. Its average distance from Pittsburg is about 110 miles.

Two Pittsburg companies now penetrate that field, namely, the Philadelphia Company, with a 16-inch line, and the Tri-Steel Company, with a 10-inch line, the latter company supplying the Royal Gas Company lines at Wellsburg and Steubenville and its own plant in several other towns, delivering its surplus to the Philadelphia Company in Pittsburg.

The Carnegie Company is also extending its Greene county line into that field, but as yet it is practically untouched and directly tributary to Pittsburg.

Natural gas is an ideal fuel, free from dirt and smoke; quick, convenient and cheap. With modern appliances more than 90 per cent. of its heat units are utilized, and it is in very general use as a domestic fuel at the present time. Few cities are furnished with gas at as low a price as Pittsburg, the net price here being 22½ cents per thousand; the net price at Buffalo being 30 cents; Toledo, 30 cents; Erie, Warren, Jamestown, Meadville, Bradford and Olean, 27 cents; and Chicago, 50 cents.

Natural gas has been a very great factor in the growth and importance of Pittsburg and its surrounding district. The writer is fully satisfied that gas fuel has come to stay. Natural gas fuel seems assured to us for many years to come, and its worthy successor already has its foot upon the threshhold.

The Supply of Natural Gas in the Pittsburg District.

The latest figures obtainable:

Combined capital of the Pittsburg companies..	$40,000,000
Miles of pipe line	2,500
Number of wells	1,200
Number of men employed	2,500
Acres of land under lease	40,000
Rents and royalties paid annually	$500,000
Cubic feet of daily consumption	110,000,000
Mills and factories supplied	500
Families supplied	40,000
Number of wells drilled annually	300

The Use of Acetylene Gas as Fuel in Chemical Laboratories.

By Mr. Arthur Lachman, *Am. Chem. Jour.*

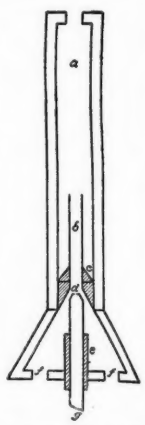
Solons who have located so many of our colleges in small towns, far from the highways of civilization, were probably actuated by the best of motives; but it cannot be denied that they have dealt unkindly with the disciples of science, by depriving them of the use of coal gas. Bunsen's ingenious introduction of this fuel into our laboratories has wrought such a change in experimental methods that the organization of a modern laboratory without a liberal supply of gas would seem an absolute impossibility. And so there have arisen the numerous substitutes which are designed to supply the place of coal gas. Of these substitutes, it would seem that "gasoline gas" enjoys the greatest popularity. This "gas" is made by simply saturating air with gasoline vapor. For this purpose a variety of contrivances are on the market, the details of which need not be considered here. It is evident at once that such a gas is open to serious objections, the chief of which is the condensation of gasoline in the pipes whenever the temperature sinks appreciably. Another objection is to be found in the comparatively small proportion of vapor to air in this gas; a sample of saturated gas which I recently analyzed for another purpose contained only 23 per cent. of gasoline vapor; and in a certain form of machine in common use, the proportion is lowered to 15 per cent., to obviate the condensation above referred to. As a result of this rather attenuated condition of the combustible vapor, it has an unfortunate tendency to blow out at the burners unless both the rate of flow and the pressure are carefully regulated to the construction of the burner.

Our laboratory is supplied with such a tantalizing fuel. In drawing up the plans for a new laboratory building, however, it was found that our machine must be either enlarged or replaced; and the opportunity was seized to ascertain whether or not acetylene would prove an adequate substitute in point of cost, convenience and feasibility. I was unable to secure data, either from the current journals or the manufacturers of acetylene burners, relative to other than the mere cost of installation; and it may therefore be of interest to other isolated chemists to record here the results of my investigations. The data which I have collected may be presented under three heads: (1) The acetylene Bunsen burner; (2) the properties of the acetylene blue flame; (3) the comparative operating expenses of acetylene and gasoline gas.

1. *The Acetylene Bunsen Burner.*—The burners employed in my experiments were kindly supplied by Mr. Breck, Pacific Coast Agent of Messrs. Colt & Company, of New York. They are ingeniously constructed of heavy brass, and have certainly solved the problem of furnishing an acetylene flame which does not deposit soot. The essential details of construction are given in the following sketch, which shows the actual dimensions.

The pin hole supplying gas is very small, and no variations of its orifice are possible; so that it is quite likely that exposure to laboratory fumes will interfere somewhat with its operation. The burner is supposed to work under a pressure of 6 inches of water, and at this pressure yields a flame about 4½ inches high and ⅛ inch in diameter. However, it begins to furnish a fairly good flame at a pressure of 3 inches; below this the flame becomes luminous.

The burner suffers from a number of defects, which are probably due more to the nature of acetylene than to errors in construction. In the first place, the flame cannot be lowered successfully; the operation requires a very delicate adjustment of the hosecock, and at best the flame is shortened not more than one inch before it becomes luminous or strikes back. This striking back is the second objection to the burner; for it invariably occurs whenever the gas is turned off. In itself, this would probably not prove objectionable; but it is accompanied by a loud report like the crack of a rifle. It is plain that such a burner would furnish considerable diversion to the average student, and play havoc with the nerves of his instructor. Incidentally, this forcible striking back forms an interesting lecture demonstration of the explosive violence of acetylene-air mixtures; for the total volume of the burner tube is not more than 5 cc.



a. Burner tube; *b.* Inner mixing tube; *c.* Cone valve for regulating air supply; *d.* Pin-hole for admitting acetylene; *e.* Screw collar for air valve; *f.* (Four) air holes; *g.* Acetylene entrance.

2. *The Properties of the Acetylene Blue Flame.*—It is a trifle incorrect to speak of the acetylene *blue* flame, for the gas burns with a purple color resembling the potassium flame. It cannot therefore be used for flame tests; the color is not absorbed by cobalt glass. Spectroscopic examination revealed the interesting fact that the phenomenon is due to a continuous spectrum, in which red is poorly developed and yellow almost entirely lacking. No lines were observable with my small instrument, even the sodium line being completely absent. The central cone of the acetylene flame is exceedingly small, being not more than $\frac{3}{16}$ inch high; it has the regular blue flame appearance, and is very hot (*cf.* below).

Very beautiful effects are obtained if the air supply is slowly cut off. At first a faint yellow central cone makes its appearance, which then becomes brilliantly white; while at the same time the outer and upper portions of the flame assume a deeper purple tint. Further diminution of air causes a second central cone to envelop the first; it is less lustrous than the latter, and stands out sharply. By very careful manipulation as many as four such cones can be formed within the same flame; and finally the whole jet becomes luminous throughout. The phenomena are well suited to illustrate the theory of combustion within the Bunsen burner.

The acetylene Bunsen flame deposits no trace of soot. However, when it is allowed to play against cooled glass surfaces, a not inconsiderable quantity of colorless oil can be collected. This oil is orthophosphoric acid, shown by its reactions with silver nitrate and with cold molybdate. For use in analytical work, the acetylene must needs be carefully freed from phosphine.

In spite of the high phosphorus content, the burning gas had no determinable effect upon platinum. A piece of very thin foil weighing 0.7 gram was loosely coiled and heated to white heat for over an hour; it had not gained even $\frac{1}{10}$ milligram. The same piece was then hung so that its lower edge was bathed by the blue central cone; further heating for an hour and a half did not alter its weight. The phosphine of commercial acetylene would thus seem to have no appreciable action on platinum. The portion of foil which had been hung in the blue flame was etched as if eaten by acid; and at one point two edges had fused together for over ¼ inch. This would indicate a very high temperature in the flame. An additional indication may be found in the much greater luminous intensity of the platinum.

Very intense effects are obtained in the acetylene blast. Using an ordinary Bunsen blast lamp with foot bellows, No. 27 platinum wire (diam. 0.33 mm.) melted as easily as in oxyhydrogen. Platinum foil was turned on its edge. In an attempt to use an oxygen acetylene blast, the blowpipe itself burned away so quickly that the experiment could not be continued. In both cases the flame was white, not colorless.

In spite of the high temperature of the acetylene flame, however, its heating capacity is very small compared with gasoline gas. This is well shown by the following test: A Jena one-liter flask was employed, containing exactly 500 cc. water. The flames were adjusted to play directly against the glass, the distance from burner tip to flask being one third the height of the full flame. The time was noted from lighting the burner until the water came to boiling:

Acetylene burner No. 1	13 min.
Acetylene burner No. 2	10 "
"Detroit" burner	4½ "

The gasoline burner was an ordinary laboratory specimen, rather below than above the average. It remains to be said in this connection that gasoline and acetylene burners have widely different gas capacities, and that herein lies a partial explanation of this great difference in heating power. This topic will be discussed again below.

3. *The Comparative Cost of Acetylene and Gasoline Gas.*—The rate of consumption was measured by noting the fall of a gasometer tank of known capacity. In these tests the above acetylene burners were used, as well as two Detroit burners; the acetylene burners were worked at a pressure of 6 water-inches, the others at the pressure of our gas machine (1¼ inches).

Burner.	I.	II	III	Iv
Consumption per hour in cubic feet.	0.83	1.0	5.9	4.3
	0.80	1.0		

These figures come very near those claimed by the manufacturers; viz., 1 and 5 feet, respectively.

Carbide is quoted here at about $6.00 per hundred pounds; gasoline costs about 25 cents per gallon laid down. One hundred pounds of carbide furnish an average yield of 5·00 feet of acetylene; one gallon 86° gasoline produces about 200 feet of "gas." Per cubic foot acetylene costs 1.20 cents, gasoline gas .0125 cents. Per burner hour the cost becomes: Acetylene 1.20 cents, gasoline .0625 cents.

To obtain an adequate idea of the cost of supplying each student with gas during the year, no accurate data are at hand; and for my purposes I have assumed that the average student, either elementary or advanced, may be fairly supposed to keep one burner in continual operation each hour he spends in the laboratory. This seems a fair allowance for waste, extravagance, the possession of several burners, and the employment of gas for general purposes (lectures, air baths, etc.) This assumption has checked with the cost of supplying this laboratory. With an average of thirty five weeks spent in laboratory work each year, the student will consume for each hour per week in gasoline 22 cents, in acetylene 42 cents. These figures are excessive, owing to the unreasonably high tariffs on the Pacific Coast; but in all probability the cost of materials is proportionately lower elsewhere. It should be noted, however, that in actual operation acetylene will be at a disadvantage owing to its smaller heating capacity, so that work such as maintaining air baths at high temperatures, prolonged evaporations, etc., will call for greater expenditure of gas than allowed for here.

4. *Conclusions.*—In answer to the question: "Will it pay a laboratory to use acetylene in place of gasoline gas." I think that the foregoing results point to the negative. In many ways, this is to be regretted, as a concentrated, non-condensible gas possesses great advantages over the article in present use. A number of points remain for discussion. The first refers to cost of installation. At first sight, acetylene appears to have the advantage. For equal burner capacity, an acetylene plant is considerably cheaper than a properly equipped gasoline generator. As the gas pipes need have only one fifth the carrying capacity otherwise called for, a very appreciable saving is affected here also. Against this, however, there is to be set the fact that a purifier which will remove phosphine is absolutely essential. There are no data upon which to base computations of the cost of this operation, but it cannot be very cheap either in installation or in maintenance. Again, even a very large acetylene generator must be cleaned out at least every two weeks, whereas the other machine can run six months without attention. The cost of burners for either system is about the same; but a laboratory already well supplied with ordinary burners must purchase a completely new outfit.

Secondly, the difficulties of adjusting the flame of acetylene to small size would preclude its use in all delicate work, such as fractional distillation, thermostat regulation, melting point determinations, etc. It certainly does not seem practical to have *two* kinds of gas in a laboratory. The use of a small, luminous acetylene jet is out of the question, on account of the inevitable heavy deposit of soot.

The small heat capacity of acetylene, which at first sight seems surprising, is readily explained upon thermochemical data. The comparison must be made between one volume of acetylene and five volumes of "gasoline gas." The latter contains about 20 per cent. of vapor, and the vapor, according to some rough experiments I have made, seems to have an average composition of C_3H_8; so that we are really comparing equal volumes of acetylene and propane. The heat of combustion of the former is about 3,100 K, of the latter 5,500 K. The remaining balance in favor of gasoline gas is probably due to the greater surface of contact which its flame presents to the heated objects.

It would thus seem that neither in cost, convenience nor feasibility can acetylene compete with gasoline as a laboratory fuel. Nor does the future seem likely to bring any adequate change in this matter. Any decrease in the cost of carbide can surely be met by the oil people; nor are the defects of acetylene as a fuel such as can be remedied by improved burner construction.

Elbers's Method for Using Mineral Wool.

According to the *Engineering and Mining Journal*, Mr. A. D. Elbers, whose studies in the properties and possible utilities of slags, slag products and mineral wool are well known, has recently taken out a United States patent—No. 653,077, dated July 3d, 1900—covering certain methods of treating and using mineral wool, which are described, substantially as follows, in his specifications. His invention relates to the conversion of mineral wool into elastic bricks, sheets, sectional pipe coverings, and similar moldings. It consists in making elastic mineral wool moldings in the manner hereinafter specified, and it also consists in the new articles of manufacture thereby produced.

Though mineral wool has been used for insulating heat and cold and sound for over 20 years past few devices have thus far either been made known or put into operation whereby this material can be applied in a practical and marketable manner, excepting to pack or stuff it in its loose state into the spaces that are to be deafened. In applying it in its loose state to boilers and steampipes it has to be held in place by a jacket or casing especially provided for that purpose, which mode of application costs about twice as much or more than the wool itself, and in deafening walls it has to be forced into narrow spaces that must be boarded up as the work of stuffing progresses, a manipulation that has to be performed with great care if the work is to prove satisfactory. Moreover, such deafenings are apt to sag considerably when they get wet. In applying ordinary mineral wool it is usually stuffed to a density of about 18 pounds to the cubic foot. It then contains about 9 volumes of air to 1 volume of solid substance, and consequently can absorb about 3 times its own weight of water, which is more than it can sustain without settling. Hence such deafenings may become seriously damaged in roofs and walls by leakage during heavy rains, and pipe and boiler coverings are apt to become affected in a similar way by the condensation of escaping steam. This renders it possible to apply mineral wool in its most desirable state of compression and consistency, as well as in shapes that are suitable for the intended application. If, for instance, a wall space is to be lined 3 feet in the clear between timbers or joists and 3 inch deep, the wool may be applied in the shape of elastic bricks 9 by 4 by 3 inch in size, of which 12 will be required for a course 1 foot high, or 36 for a square yard. A brick of that size will weigh nearly 1¼ pounds, or at the rate of 27 pounds to the cubic foot, and at that weight it will contain nearly 5½ volumes of air to one volume of solid substance, at which density the material attains about its highest degree of efficiency as a non-conductor. In laying the bricks they are to be pressed against each other rather tightly, and then the courses will stay in place and may be carried up to the ceiling without being boarded up. The bricks may also be cemented together by wetting their contacting surfaces with a suitable agglutinating solution, but this is not necessary if the deafened spaces are later on to be lathed or boarded up. For covering boilers the wool can be molded into sheets that are sufficiently pliable to be bent to the required curvature, and for covering pipes it can be molded into semicircular sections about 1 foot long that are easily fastened upon the pipes with a piece of string or wire. For all of these applications it is essential that the moldings should be somewhat elastic (as otherwise they could not be joined tightly by merely pressing them together) as well as sufficiently tough to withstand rather rough usage, the latter property being especially desirable for the commoner or cheaper products, such as the bricks, because they may then be shipped in bulk.

The agglutinating properties of more or less diluted solutions of silicates of soda and potash are well known, and even the solutions of caustic alkalies and their carbonates have similar though less pronounced effects on such compositions as mineral wool consists of. It might, therefore, be considered a very simple matter to convert mineral wool into molded material of the desired properties by reducing it in admixture with such solutions to a wet pulp, pressing the latter in molds and drying the moldings; but even the finest mineral wool is not sufficiently plastic for such treatment, because it contains a large amount of shot or sand-like particles that are intimately intermixed with or adhere to the fibrous parts. If such a mass is stirred in the wet state, the shot separates by gravity and collects in spots, and the plasticity of the mass becomes thereby reduced to such an extent that it will not hold together after molding unless it has been treated with an agglutinating solution of such strength that the moldings will become hard and brittle in drying. Moreover, a mineral wool pulp that has been completely saturated with a solution becomes too compact to yield moldings of sufficient lightness.

It is best to treat the mineral wool at or near the works where it is made in order to be able to obtain it without much handling direct from the collecting chambers into which it is blown. This is almost a necessity, because the vitreous fibers break at every handling, so that when once packed for shipment in bags or barrels they form lumps of different degrees of compactness and then cannot be loosened again like cotton or other organic fiber, to be made up into a uniform material. The wool can be easily taken out of the collecting chambers in rather uniform layers, compressed to a density of about 10 or 12 pounds to the cubic foot, which is about the best condition for pressing it into molds. For articles of compact form and plane surfaces, such as bricks, the mold need only consist of a rectangular frame open at top and bottom and resting on a flat tray.

More complicated forms need not be here considered, because any practical molder will readily know how to construct them after becoming acquainted with the peculiarities of the material, as herein described. The brick molds may be made either of wood or of sheet metal. Their depth should be about one sixth more than that of the moldings that are to be turned out, and they should be perforated or provided with small holes on all sides for the purpose of allowing the air to escape more freely while the wool is being compressed in them. The wool should be pressed in by hand until it will bulge out a little when the pressure is relaxed. After a mold has been filled in that way it is to be reversed in order to see whether the bottom surface has become uniform or whether it requires some more stuffing. When the contents are in good shape, about as much of the agglutinating liquor is poured into the tray as the weight of the compressed wool amounts to. The liquor is rapidly soaked up, especially if the mold is once reversed, so that both open surfaces become exposed to capillary action. If the mass is slightly pressed while this action is progressing, the liquor penetrates the whole mass without filling its interstices completely. Hence only from 100 to 125 pounds of liquor are required for impregnating 100 pounds of mineral wool, whereas nearly 200 pounds would be required to saturate that quantity completely. When the contents of the mold are thoroughly moistened, they are subjected to a slight pressure, which is best performed with a lid or plunger that fits into the mold in order to reduce the thickness of the molding to the desired dimensions. The brick is then pressed out of the mold and placed on a board for preliminary drying, and after one or two hours it may be taken to a drying room, where it will lose all of its moisture within three to four hours, provided the temperature of the room is kept up to about 300° F. The dried brick is then ready for use, and, if properly made, of sufficient toughness to be shipped in bulk. The required manipulations may be varied in various ways and some of them may be performed by well known mechanical and automatical appliances.

The agglutinating liquor is prepared by preference from the liquid silicate of soda of commerce, which usually consists of from 45 to 47 per cent. of the anhydrous substance and from 55 to 53 per cent. of water. Calling this, for short, a 50 per cent. solution, by reducing it to a 1 per cent. solution (by mixing 1 pound with 49 pounds of hot water) a liquor is obtained that has sufficient agglutinating power to answer the purpose of bonding compressed mineral wool, and with a 2 per cent. solution bricks have been made that retain their shape after

having been immersed in hot water (212° F.) for three hours. A 4 per cent. solution is apt to render the surfaces of the moldings too inelastic. Stronger solutions are apt to render them quite stiff and brittle, and as the invention consists in making elastic mineral wool moldings, only the use of highly attenuated agglutinating solutions and, in the case of silicate of soda, solutions having a lower specific gravity than 1.05 is claimed.

Dearer Fuel in Great Britain.

Iron Age says that the high prices of coal and coke continue to disturb British iron and steel manufacturers. It appears that the coal mining companies of Great Britain quite generally drew their recent contracts so that they would expire June 30, thus enabling them to advance prices simultaneously July 1. This advance was so great as to cause almost a feeling of consternation among manufacturers of iron and steel. Alluding to this subject, the *Ironmonger* for the 14th ult. says: "There is no doubt that many industries will be seriously affected by the enormous cost of both coal and coke, and it is pretty safe to say that there are very few iron and steel manufacturers depending upon outside sources for their fuel who can afford to view the future with equanimity."

The condition is sufficiently grave to be alluded to as a "coal trade crisis." In a face of a distinctly weaker tendency in the iron market, British manufacturers are thus handicapped by an increased cost of production due to the high price of fuel. At a time when they are extremely solicitous of reducing costs they find one of their most important materials sharply advancing. And this advance is not made from a low level, but is an additional enchancement of prices that had previously been quite high. The mine owners are masters of the situation, inasmuch as they are having not only a heavy demand for export, but also an extraordinary trade from their home manufacturers. They are able to get the prices they ask and are not moved by considerations of compassion for their customers.

For the time being this situation will operate to the advantage of British competitors, including prominently the manufacturers of this country. On this point the *Ironmonger* says: "Our greatest competitor in the iron and steel industry—the leading manufacture in this country so far as the consumption of fuel is concerned—is the United States.

"Even under ordinary circumstances the American maker can turn out pig iron at a lower price than can the British ironmaster; but when the latter is called upon to pay fancy prices for his fuel the divergence becomes more and more marked, and there can be little doubt that the action of the colliery owners is in reality putting a premium upon the American iron and steel manufacture." Cheap fuel is enjoyed in America, and from present appearances it is likely to continue cheap and even become more so. The stagnation in our home trade causes foreign markets to be sought with avidity, and anything that handicaps our competitors is of special value to us just now. Eventually the inroads that may be made in the trade of British manufacturers will cause diminished industrial activity in Great Britain and a decline in the demand for British coal, which will cause a reduction in its price. But in the meantime the situation must be decidedly unsatisfactory from the British manufacturer's standpoint.

British Regulations Concerning the Distribution of Electricity.

Engineering Record says that few people in this country, where electric distribution is governed only by city ordinances and regulations, understand how minutely the business is controlled by national laws abroad. For this reason it is believed that the following summary of British legislation on the subject, recently printed by *The Architect*, will be of general interest in the United States.

The supply of electricity is controlled by Parliament under the Electric Lighting Acts of 1882 and 1888, and the Electric Lighting Clauses Act of 1899 (which are defined as the principal acts), and is authorized by provisional order (called the special order), which is subject to the rules and regulations of the Board of Trade. It is proposed here to consider the position of the public with regard to the question generally.

Right to a Supply—Within two years of the date when an order is granted, mains must be laid in certain streets which are scheduled in that order (called the compulsory area). Any person may require a supply of electricity on the same terms and conditions as any other person in those streets, providing the premises are at a not greater distance than 50 yards from the mains. The supply authority, however, may require the cost of the length of service main which is upon the premises, and any length above 20 yards from the distribution main, to be refunded. The supply authority may also require a contract to be entered into guaranteeing to take a supply for not less than two years, of such a quantity, the payment for which will not be less than 20 per cent. per annum of the cost incurred by the supply authority in connecting to the mains. Security may also be required for such payment.

The supply authority may be required after eighteen months from the grant of the order to lay down mains in streets in the area over which they have the right to supply other than those scheduled as the compulsory area, providing applications are made for a supply in at least six premises in one street, but the supply authority may require a guarantee (from the six applicants) that the supply will be taken for three years, and produce not less than 20 per cent. per annum of the cost incurred in laying the additional mains. The number of applications and the guarantee are, however, subject to variation, either in the order or by arbitration, according to the special circumstances of the case.

The supply authority before laying a special service main to any particular premises, the main not being for a general supply, must give twenty eight days' notice to all persons whose premises the proposed mains will pass, and any two applicants may obtain a supply from the same service main, in which case it must be laid as a public main.

After a supply of electricity has been given the supply authority may require security within seven days for the payments which may become due, and may cut off the supply until such security is given. The supply authority, however, is bound to pay interest on such security at the rate of 4 per cent. per annum, payable every six months.

Method of Supply.—The system of supply must be approved by the Board of Trade, and subject to rules and regulations for the protection of the public with regard to safety and sufficiency of supply. The supply authority must state the standard pressure before commencing a supply to any premises, and this pressure, which must be below 250 volts, must not be departed from to a greater extent than 4 per cent.

The supply when once given must not be discontinued except for testing, when notice must be given to the consumer if the period of disconnecting is to exceed one hour. The pressure of supply must not be altered without the consent of the local authority or the Board of Trade, and in the event of any change of pressure the Board of Trade or local authority may enforce conditions upon the supply authority. These conditions usually are to the following effect:

The supply authority must give one month's public notice of their intention to apply for permission to alter the pressure. The supply authority must replace all apparatus on a consumer's premises free of charge which may become inefficient, dangerous or useless by the alteration of pressure, and must leave the wiring, fittings and other apparatus on the consumer's premises in good condition, and suitable for efficiently utilizing the supply at the altered pressure.

It is to be noted that no change must be made in the pressure of supply without the consent of the consumer if the supply was given previous to the date of issue of the Board of Trade regulations (1896.)

The penalty for breach of any regulations under this heading by the supply authority may amount to £5 per day.

Wiring and Fittings.—As to the wiring, lamps, fittings and other apparatus on the premises for the use of the electricity, the supply authority cannot specify any special type or make, except so far as to insure that the supply to other premises will not be interfered with or neglected by the use of defective apparatus, and it is for this reason that the supply authority issue rules.

It is difficult, however, to define exactly how far the rules made by the supply authority are enforcible. The act of 1888 allows regulations to be made by the Board of Trade and the local authority (if not the supply authority). The rules of the Board of Trade relate to the safety of the public, and the regulations as to supply. The Clauses Act (1899) states to the effect that the supply authority is not compelled to give a supply, unless "reasonably satisfied" that the wiring, fittings and apparatus are in good order and condition, and are not calculated to affect injuriously the use of energy by the supply authority or others. The Board of Trade regulations state that no installation shall be connected

to the mains if the leakage is more than 0.0001 of the maximum supply to the premises. The penalty for default of the supply authority in complying with the Board of Trade regulations before mentioned is not exceeding a daily penalty of £10, and in addition compensation for damage sustained.

All apparatus necessary for giving a supply on a consumer's premises, other than the meter and service mains, has to be provided and maintained entirely at the cost of the supply authority, and must be placed between the mains and the consumer's terminals.

Charges for Supply.—As previously mentioned, there must be no preference; any person may demand a supply on the same terms as any other, although the rate of charge may be agreed upon, and must not exceed that specified as the maximum in the order, which is usually 8d. per unit, with a minimum charge of 13s. 4d. This minimum charge, however, is seldom enforced, and the charge is generally less than the maximum stated.

The method of charge must be by meter unless otherwise arranged.

The supply authority is bound to supply, except it is otherwise arranged, on the basis of the amount of electrical energy used, or by the quantity of electricity supplied at an assumed constant pressure. Notice must be given by the supply authority before a supply is commenced in any main, of the method of charging to be adopted, and the method may not be altered except by giving one month's notice to every consumer.

The maximum charge or methods allowed for charging may not be altered except by permission of the Board of Trade, who may hold an inquiry and who may only sanction an alteration after seven years have elapsed from the previous fixing of the charges or method of charging.

The alteration of any method of charging may involve change of meters or instruments, and any cost of this must be paid by the supply authority.

There is no limit (except by special agreement with the local authority) as to the dividends which may be paid by the supply authority (if a company), and there is therefore no enforced reduction of charges as with the supply of gas. Special orders have, however, been consented to by the local authority in many cases, only on certain conditions as to reduction in charges, although when the local authority is the supply authority, if the net profit exceeds 5 per cent. of the capital, a reduction in price must be made to keep the profit down to this.

Meters.—The meter may be provided by the consumer or by the supply authority, at the option of the former, and must in either case be kept in repair by the owner. Unless it is otherwise agreed, the meter must be of a pattern which has been approved by the Board of Trade, and also must be actually certified as accurate by the electrical inspector appointed by the local authority or Board of Trade for that purpose. There is no limit as to meter rents when the meter is provided by the supply authority, but the consumer always has the option of providing it. The accuracy of any meter must be tested on the application of either the supply authority or the consumer, and if found accurate the applicant pays the cost of re-certifying.

Electrical Inspectors.—The local authority, when not the supply authority, may appoint an electrical inspector, and if the local authority is the supply authority the Board of Trade may, on the application of any consumer, do so.

An electrical inspector is, as it were, an arbitrator who comes between the supply authority and consumer and settles points in dispute. The duties of the electrical inspector comprise the following: (a) To inspect and test the supply authority's mains and to test the supply given to consumers; (b) to examine and certify meters; (c) to carry out other duties specified in the order and the regulations of the Board of Trade, such as testing of wiring and fittings.

Nuisance.—There is another matter of great interest to the public, even though not consumers, namely, that of nuisance. Under a provisional order the supply authority is not exempt from penalties being inflicted for nuisance, whether being caused by smoke, vibration, opening of roads or otherwise.

No President to succeed the late Mr. Bernard M. Shanley has been named by the Essex and Hudson Gas Company, of Newark, N. J., nor is it likely that a presiding officer will be named until some time in September. Meanwhile the Vice President, Mr. George R. Gray is carrying on the chief executive branch, and his action in that respect has been of the smoothest sort.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Councilman Cassidy and Alderman Geiser, of the Borough of Queens, N. Y., have been appointed a committee to investigate a complaint made against the Newtown Gas Company that it is charging $1.25 per 1,000 cubic feet for gas, while the legal rate in Greater New York for 1900 should not exceed $1.05 per 1,000. This complaint has no foundation in law, for the rate in the district supplied by the Newtown Company was fixed by the Legislature of the State in 1892, by special act, at $1.25.

The proprietors of the Standard Gas Company, of Keyport and Matawan, N. J., have applied to the Council of South Amboy, N. J., for the right to operate a gas works there.

Messrs. George D. Rosenthal, Owen Ford and Josephine Rosenthal have incorporated the Jerseyville Light, Heat and Power Company, to operate gas and electric light plants and a water works in Jerseyville, Ills. It is capitalized in $25,000. Jerseyville is the capital of Jersey county, Ills., and is located on the Jacksonville division of the Chicago & Alton Railroad, at a point 20 miles northwest of Alton. It is quite a busy place, and has a population not far from 5,000.

The authorities of Chamberlain, South Dakota, have granted a franchise to Messrs. Blodgett & Douthett, of Mitchell, S. D., under which they may operate a gas works in the first named place.

The property and rights of the Camden (N. J.) Gas Light Company have been purchased by the syndicate which controls the gas and electric lighting properties of Trenton, N. J. Steps will be taken at once to connect its main system with Haddonfield and other nearby towns. We understand that Mr. Charles Watson, President of the Company, will be retained as Manager, for the present at least.

At the annual meeting of the Spencer (Mass.) Gas Company the Directors chosen were: Erastus Jones, F. A. Drury, Noah Sagendorph, Frank E. Dunton and Dexter Bullard.

It is reported that the Aurora (Ills.) Street Railway and Power Company will construct an opposition gas works in Aurora. The railroad men will make a mistake if they carry out that proposition.

The proprietors of the Waltham (Mass.) Gas Company have declared a dividend of $3 per share.

The sales of gas by the Peoples Gas Light and Coke Company, of Chicago, for the second quarter of the year, as compared with the corresponding quarter for 1899, show a gain equal to 15.7 per cent.

The Fidelity Gas Light Company, of Hoosick Falls, N. Y., is adding greatly to its generating facilities.

Our reports on sendout account for the past six months, as compared with the first half of 1899 show surprising gains.

Supplementing "H.'s" paragraph which was printed in the Journal for last week, respecting betterments for the plant of the Bridgeton (N. J.) Gas Light Company, "F." writes this week as follows: "The Bridgeton (N. J.) Gas Light Company's business having grown under the skilful guidance of its Superintendent, Mr. B. F. Harding, to proportions that the present plant will not satisfactorily handle, the Company has decided to remodel and enlarge its works from a 6 inch to a 10 inch basis. The work is under the supervision of Mr. F. H. Shelton, of Philadelphia, and the plans contemplate new benches, purifiers, scrubber, condenser, exhauster and meter. Contracts for the apparatus have been placed."

Mr. John Clements, ex President of the Pacific Coast Gas Association, and formerly Superintendent of the Red Bluff (Cal.) Electric Light and Gas Company—he acted as such from January, 1890 to February, 1900—has accepted the Superintendency of the Salinas City (Cal.) Gas and Water Company. That his administration of its affairs will be successful does not admit of doubt, and he takes to his new field of duty the esteem and good will of every resident of Red Bluff, where his home was since 1869.

The River Shore (N. J.) Gas Company, of Riverton, N. J., has completed its 3-inch main to Moorestown, 4½ miles distant, and is now supplying gas to the latter place by high pressure, upon the lines suggested by Mr. F. H. Shelton, Engineer to the Company.

AT the annual meeting of the shareholders in the Northampton (Mass.) Gas Light Company, the officers chosen were: Directors, J. F. Starr (Camden, N. J.), L. Clark Seelye, C. N. Clark, E. H. Banister and D. W. Crafts; President, C. N. Clark; Secretary and Treasurer, E. H. Banister; Superintendent, D. W. Crafts; Assistant Treasurer, Roderick M. Starkweather; Assistant Superintendent, Harry C. Crafts. A semi-annual dividend of 4 per cent. was declared, and an extensive scheme of main increase was mapped out. The Company is very prosperous, as it should be, if careful management is to count.

MR. L. A. BERTHOLF, recently with the Bergen County (N. J.) Gas and Electric Company, has taken charge of the gas supply at Downington, Pa., at which place the gas plant was recently purchased by Messrs. John Gribbel and F. H. Shelton, in the interest of the Coatesville (Pa.) Gas Company, adjoining. Extensive improvements to the plant at Downington will be made. The business at Downington in the past was indifferently handled, but the promise for the future there is very bright.

THAT the hands of a clever manager are at the helm of the gas ship of Sunbury, Pa., may be noted from the following: Upon the occasion of a recent circus parade there, Mr. George W. Beck, Superintendent of the Sunbury Gas Company, constructed out of lath and canvas a life size dummy elephant. Two men served as the legs. This elephant, decorated with a large blanket, reading on either side, "Cook by Gas," gravely followed the parade throughout, being much observed and convulsing the townspeople with merriment. The beast's latest advertising dodge was the delivery of a gas range, while hitched to a light wagon.

ACCORDING to the statement submitted to the City Controller of Philadelphia by the United Gas Improvement Company, respecting its operation under lease of the Philadelphia gas works for the quarter ended June 30, 1900, it is shown that the quantity of gas sold in that quarter amounted to 871,260,690 cubic feet, as against 782,664,780 cubic feet for the quarter ended June 30, 1899.

THE Goshen (Ind.) Gas Company is completing an installation of benches by the Parker Russell Mining and Manufacturing Company.

THE proprietors of the Pittsfield (Mass.) Coal Gas Company have purchased 15 acres of land on Pomeroy avenue in the eastern part of the city, on which it is proposed to construct a new works to be built on coal gas lines. It is not likely that construction work will be proceeded with until next spring. Treasurer Plunkett estimates that the new plant will cost close to $100,000. The scheme includes the building of a holder, of a capacity not less than 250,000 cubic feet.

MR. RALPH W. POPE, Secretary of the American Institute of Electrical Engineers, has issued the following notice to the members, respecting the proposed trip to London and Paris:

"Members are requested to register at the Institution of Electrical Engineers, 28 Victoria street, Westminster, S. W., London, and send Continental address to R W. Pope, 26 Cortland street, New York, up to July 31st, after that care of McGraw Publishing Company, Palace of Electricity, Exposition, Paris. By courtesy of the Institution of Electrical Engineers the following programme has been arranged:

"London, Sunday, August 12th.—Trip up the Thames by rail to a convenient point, thence by electric launches, returning by same route after lunch.

"Monday, August 13th.—Dinner in the evening.

"Monday and Tuesday.—Visits will be arranged to works, etc., in the vicinity of London.

"Wednesday, August 15th.—Special train to Paris.

"Paris, Thursday, August 16th.—Joint meeting by courtesy of Commissioner Peck in the U. S. Pavilion. Subject for discussion: 'The Relative Advantages of Alternate and Continuous Currents for a General Supply of Electricity, Especially with Regard to Other Interests.' The special point which the British Committee would like to have discussed is: 'How far will interference with other undertakings, rather than ordinary commercial and industrial conditions, be the factor which will determine whether continuous or alternating currents shall be employed.'"

THE Philadelphia Suburban Gas Company is now putting in a large installation of high pressure gas delivery mains upon the lines recently described and advocated by Mr. F. H. Shelton, of Philadelphia. This system, which is the third of its kind, is about half completed. At the present writing, gas is being delivered to the Eddystone Mills, 7 miles from the starting point, with entire smoothness and satisfaction, and with no visible evidence to the user that it has been compressed to 25 pounds and transmitted the distance involved through but a 6-inch pipe. The satisfactory working of the several high pressure lines now underway must be a pronounced gratification to Mr. Shelton.

AT the annual meeting of the Consolidated Gas Company, of Long Branch, N. J., the following Directors were elected: Emerson McMillin, Emanuel Lehman, J. G. Beemer, John S. Foster, F. W. Hope, Jacob Steinbach, H. B. Wilson, G. Maas and W. F. Douthirt.

A CORRESPONDENT writing from San Francisco, Cal., under date of the 24th of July, says: "Yesterday the necessary papers changed hands which give to Mr. John A. Britton, Manager of the Oakland Gas Light and Heat Company, absolute control of the stock of the Oakland Equitable Gas Company, which concern was organized about two years ago. The deal was engineered by William J. Landers, Chas. Ackerman and ex-Senator F. J. Moffit, though the latter insists that he had very little, if anything, to do with the transaction. It is said, however, that Moffit is a shareholder in the profits of the deal to the extent of several thousand dollars. When the Equitable was formed its backers were W. J. Dingee and Banker Henshaw. Their idea was to make gas by the Chisholm method, but later it was found that the process was not all that was claimed for it, and stock which had been sold to the extent of nearly $200,000 depreciated considerably in value. Still later, when an assessment was levied, it dropped still lower, until it was bought up by Landers and Ackerman at a little over $1 a share. In the meantime, however, a plant had been constructed along the water front, and every appearance seemed to indicate that the work of laying mains would soon be begun. Landers and Ackerman, however, decided there was more money in selling out than in operating a gas plant, so they gradually began picking up all the stock they could get hold of. When they had the bulk of the stock they opened negotiations with Britton, and closed the deal. This was about three weeks ago, but the formal transfer of the stock was not made until to-day. The net profits to the men who put the deal through with Britton are in the neighborhood of $75,000, and of this amount Landers gets the lion's share. The original promoters of the scheme will, it is said, come out with a very small profit. The plant of the Equitable, it is said, will be operated in connection with the plant of the Oakland Gas Light and Heat Company."

The Combination of Gases by the Agency of Spongy Platinum.

The *Journal of Gas Lighting* notes that Mr. W. French, of the Grammar School, Bury, has been experimenting in order to ascertain the nature of the part played by spongy platinum in effecting the combination of some gaseous mixtures, especially mixtures of hydrogen and oxygen. It has long been known that this effect is producible under ordinary conditions; but the nature of the operation of the platinum is obscure. Mr. French tried purifying the gases and carefully drying them and the platinum before allowing these elements to come into contact with one another, both in the presence and in the absence of light. Incidentally, while the arrangements for purifying the gases were in progress, some of the waste or escaping gases from the apparatus were brought into contact with spongy platinum, and combination was always effected. A certain interval of time invariably elapsed between the addition of the platinum and the actual explosion; and Mr. French reports in the *Chemical News* that he thought the interval was less in broad daylight, or when burning a piece of magnesium near the tube, than at night when most of the experiments were carried out. In the case of the dried and purified gases, in no instance did the addition of pure and clean platinum cause combination. He next tried to find the conditions necessary to provide rapid action, but without definite result. Even damping the gases with water was powerless to bring about the effect. Consequently, Mr. French concludes that finely divided platinum does not, by itself, bring about the combination of a mixture of purified hydrogen and oxygen at ordinary temperatures. The combination of these gases, when not carefully dried, in presence of spongy platinum, seems to be influenced by light. Meanwhile, the nature of the part played by the platinum remains a mystery.

The Market for Gas Securities.

The market for city gas shares was absolutely lifeless last week, but prices were well maintained. In fact, if any change in values could be noted, the change was upward. Scalpers are bidding 5 for the subscription rights, without much doing in the transfer line, holders evidently, and with good judgment, preferring to take up the stock. New Amsterdam bonds are up to 105½ bid, and they look cheap at that figure. Consolidated closed to day (Friday) at 178½ to 179.

Brooklyn Union has experienced a nominal set back, being quoted under 170. An order, however, for 500 shares would send it to 180 or over. Peoples, of Chicago, is steady, as it might well be, considering the important increases that are being made in its output. Baltimore Consolidate is stationary. The management is at last moving sensibly in the matter of bettering the plant. There isn't any market for Bay State. Equitable (N. Y. City) first Consolidated long term 5's are 120, bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

AUGUST 6.

☞ All communications will receive particular attention. ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$4,595,200	100	178¼	178¾
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	105½	106
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	121	125
Preferred	5,000,000	100	141	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,620	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	168	168¾
" " Bonds (5's)	15 000,000	1,000	116	119
Bay State	50,000,000	50	1¼	1¾
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	.	35
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5¾
" " Bonds, 5's	5,250,000	1,000	64	67
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,720	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	200¾	201
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	54½	55¼
Mortgage, 6's	3,800,000	..	..	113
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	13
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	94	94¾
" Prior Lien 5's	4,598,000	1,000	99¼	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	95	100
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co	250,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	74	75
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½
Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Madison Gas & Elec. Co.	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	183	184½
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	98¾	99
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅝	111⅝x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	3,150,000	50	88	..
Preferred	2,150,000	50	116	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	15
Bonds	1,612 000	1,000	88½	93
Washington, D. C	2,000,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,830,500	.	104	106
Wilmington, Del.	600,000	50	200	210

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	235
Fred. Bredel, Milwaukee, Wis.	227
Geo. R. Rowland, New York City	233
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	233
American Gas Co., Phila., Pa.	233
David Leavitt Hough, New York City	232
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	219
Baxter & Young, Detroit, Mich.	232
United Gas Improvement Co., Phila., Pa	227
James T. Lynn, Detroit, Mich.	232
A. E. Boardman, Brevard, N. C.	232

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	236
Continental Iron Works, Brooklyn, N. Y.	234
Deily & Fowler, Phila., Pa.	236
Kerr Murray Mfg. Co., Fort Wayne, Ind	232
Stacey Mfg. Co., Cincinnati, Ohio	233
Bartlett, Hayward & Co., Baltimore, Md.	233
Davis and Farnum Mfg. Co., Waltham, Mass.	238
R. D. Wood & Co., Phila., Pa.	234
Isbell-Porter Company, New York City	234
Fred. Bredel, Milwaukee, Wis.	232
United Gas Improvement Co., Phila., Pa.	227
National Gas and Water Co., Chicago, Ills	220
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	219
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	233
American Gas Co., Phila., Pa.	222
Logan Iron Works, Brooklyn, N. Y.	236
Riter-Conley Mfg. Co., Pittsburgh, Pa.	235
Baxter & Young, Detroit, Mich.	232
American Bridge Co., New York City	221
G. Shepard Page's Sons, New York City	232
James T. Lynn, Detroit, Mich.	232
A. E. Boardman, Brevard, N. C.	232
Sutherland Construction & Improvement Co., N.Y. City	220
Chris. Cunningham & Son, Brooklyn, N.Y.	218

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	233
United Gas Improvement Co., Phila., Pa.	227
Burdett Loomis, Hartford, Conn.	234
National Gas and Water Co., Chicago, Ills.	220
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	219
The Western Gas Construction Co., Fort Wayne, Ind.	200
Humphreys & Glasgow, New York City	233
Sutherland Construction & Improvement Co., N.Y. City	220
B. E. Chollar, St. Louis, Mo.	220

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa.	234
James R. Floyd's Sons, New York City	236
Continental Iron Works, Brooklyn, N. Y.	234
Logan Iron Works, Brooklyn, N. Y.	236
Riter-Conley Mfg. Co., Pittsburgh, Pa.	235

TAR AND CARBONIC ACID EXTRACTOR.

R. D. Wood & Co., Phila., Pa.	234

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	216
American Gas Company, Phila., Pa.	222

GAS METERS.

John J. Griffin & Co., Phila., Pa.	240
American Meter Co., New York and Philadelphia	239
Helme & McIlhenny, Phila., Pa.	239
D. McDonald & Co., Albany, N.Y.	237
Nathaniel Tufts Meter Co., Boston, Mass.	238
Maryland Meter and Mfg. Co., Baltimore, Md.	238
Metric Metal Co., Erie, Pa	239
Keystone Meter Co., Royersford, Pa.	238
Detroit Meter Company, Detroit, Mich.	199

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	239
John J. Griffin & Co., Phila., Pa.	240
D. McDonald & Co., Albany, N.Y.	237
Helme & McIlhenny, Phila., Pa.	239
Nathaniel Tufts Meter Co., Boston, Mass.	238

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City	224
R. D. Wood & Co., Phila., Pa.	234
Warren Foundry and Machine Co., New York City	224
Donaldson Iron Co., Emaus, Pa.	224
Chris. Cunningham & Son, Brooklyn, N.Y.	218
Cornell & Underhill, New York City	224
Charles Millar & Son Co., Utica, N. Y.	224

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City	219

GAS TAPPING MACHINES.

George Light, Dayton, O.	217
H. Mueller Manufacturing Company, Decatur, Ills.	217

FLEXIBLE JOINTS.

Campbell Mfg. Co., Stamford, Conn.	176

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	229

GAS COALS.

Penn Gas Coal	231
Perkins & Co., New York City	230
Despard Gas Coal Co., Baltimore, Md.	231
Westmoreland Coal Co., Phila., Pa.	231
Berwind-White Coal Mining Co., New York and Phila.	230

CANNEL COALS.

Perkins & Co., New York City	230
Greasy Creek Cannel Coal and Tramway Co., Chicago	216

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills.	219

GAS ENRICHERS.

Standard Oil Co., New York City	231
The Sun Oil Co., Pittsburgh, Pa.	231

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	231

GAS GAUGES.

The Bristol Co., Waterbury, Conn.	218

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City	220
Isbell-Porter Co., New York City	234
R. D. Wood & Co., Phila., Pa.	234
Wm M. Crane Co., New York City	217

CEMENTS.

C. L. Gerould, Galesburg, Ills	238

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J. ... 223
Adam Weber, New York City ... 228
Laclede Firebrick Mfg. Co., St. Louis, Mo. ... 223
Cyrus Borgner, Phila., Pa. ... 228
James Gardner, Jr., Co., Pittsburgh, Pa. ... 228
Henry Maurer & Son, New York City ... 228
Baltimore Retort and Firebrick Co., Baltimore, Md. ... 228
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 228
Brooklyn Firebrick Works, Brooklyn, N. Y. ... 228
Missouri Firebrick Co., St. Louis, Mo. ... 228

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. ... 233
Fred. Bredel, Milwaukee, Wis. ... 222
J. H. Gautier & Co., Jersey City, N. J. ... 228
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 228
Adam Weber, New York City ... 228
Missouri Firebrick Co., St. Louis, Mo. ... 228

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City ... 234
Continental Iron Works, Brooklyn, N.Y. ... 234
Logan Iron Works, Brooklyn, N. Y. ... 236
R. D. Wood & Co., Phila., Pa. ... 234

INCANDESCENT GAS LAMPS.

Welsbach Company, Gloucester, N.J. ... 226

BURNERS.

C. A. Gefrorer, Phila., Pa. ... 234
Wm. M. Crane Co., New York City ... 19
D. M. Steward Mfg. Co., Chattanooga, Tenn. ... 219

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. ... 219

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila. ... 226
Thos T. W. Miner, New York City ... 217

PURIFIERS.

Stacey Mfg. Co., Cincinnati, O. ... 240

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 229

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y. ... 218
Chapman Valve Manufacturing Co., Boston, Mass. ... 218
R. D. Wood & Co., Phila., Pa. ... 234
Continental Iron Works, Brooklyn, N. Y. ... 234
The P. H. & F. M. Roots Co., Connersville, Ind. ... 223
Isbell-Porter Co., New York City ... 234
The Western Gas Construction Co., Fort Wayne Ind. ... 200
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 232

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind. ... 223
Isbell-Porter Company, New York City ... 234
Connelly Iron Sponge and Governor Co., New York City 229
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 232

ELECTRICAL APPARATUS.

Wm. Henry White, New York City ... 235

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City ... 217

PURIFIER SCREENS.

John Cabot, New York City ... 218

GAS STOVES.

American Meter Co., New York and Philadelphia ... 225
Maryland Meter and Manufacturing Co., Baltimore, Md. 238
Keystone Meter Co., Royersford, Pa. ... 238
Nathaniel Tufts Meter Co., Boston Mass. ... 238
Wm. M. Crane Co., New York City ... 217

HOT WATER HEATERS.

Wm. M. Crane Co., New York City ... 216

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. ... 233

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. ... 233
Continental Iron Works, Brooklyn, N. Y. ... 234
Deily & Fowler, Philadelphia, Pa. ... 236
Davis & Farnum Mfg. Co., Waltham, Mass. ... 232
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 232
Stacey Mfg. Co., Cincinnati, Ohio ... 235
R. D. Wood & Co., Philadelphia, Pa. ... 234
Logan Iron Works, Brooklyn, N. Y. ... 236
Riter-Conley Mfg. Co., Pittsburgh, Pa. ... 235

STORAGE TANKS.

Chris. Cunningham & Son, Brooklyn, N.Y. ... 218

GAS SECURITIES.

Henry Marquand & Co., New York City ... 216

ADVERTISING.

J. Howland Harding, New York City ... 216

BOOKS, ETC.

Newbigging's Handbook ... 237
Field's Analysis, 1899 ... 231
Scientific Books ... 230
Digest of Gas Cases ... 231
Practical Photometry ... 224
Gas Flow Computers ... 228
Hughes' "Gas Works" ... 229
Gas Engineer's Pocket-Book ... 224
Excerpts from Reports of Gas Commissioners ... 230
Binders ... 224
Directory of Gas Companies ... 235
Practical Handbook on Gas Engines ... 237
Coal Tar Tree ... 230
Poole on Fuels ... 224

POSITION WANTED

As Superintendent of Gas Works,

By a young man who is a hustler for new business; has experience in selling gas stoves, understands the manufacture of coal and water gas in detail; is assistant to superintendent of works with an output of 1,000,000 cubic feet per day.
1313-1 Address "G. L.," care this Journal.

Position Wanted

By a Man who is not Afraid of Hard Work.

Has had 20 years' experience in all the departments—manufacturing, distribution, new business and office work.
Address "W."
1296-tf Care this Journal.

Position Wanted

As Manager or Engineer of a Gas Company.

Thoroughly Competent Gas Manager of many years' experience in the manufacturing and the executive ends of a Gas Company desires a position as Manager or Engineer of a Gas Company selling not less than 50,000,000 cubic feet per annum. Highest references given. Address "T."
1267-tf Care this Journal.

TO GAS COMPANIES.

Position Wanted by a Young Man as Assistant Superintendent.

Now with the U. G. I. Company, of Philadelphia. Has had two years' experience laying the services and new mains of the Company in that city.
Address VAUGHN W. DUKE,
1313 3 127 N. 10th Street, Philadelphia.

FOR SALE.

CONDENSERS.

One cast iron, multi-tubular, water cooled condenser, with by-pass; capacity, 500,000 feet per diem.
One P. & A. tar condenser, with by-pass; capacity, 150,000 feet per diem. Address
1313-1 GAS LIGHT COMPANY OF AUGUSTA, GA.

FOR SALE.

PURIFIERS.

Two 8 by 10 purifiers, with 8-inch center seal and connections. Center seal made for four purifiers. All in good condition. Address C. M. KELLER,
1312-tf Columbus, Ind.

FOR SALE,

A New Condenser and Scrubber,

Each 11 feet 6 inches high, 3 feet in diameter, inside measurement, and 6-inch connections—all connections reinforced. Two manholes to scrubber, with two sets of trays; also one 6-inch center valve. These have never been used.
Address PEEKSKILL GAS LIGHT COMPANY,
1300-tf Peekskill, N. Y.

PLANS ADVICE WRITING ILLUSTRATING
J. HOWLAND HARDING, ADVERTISING,
1345 BROADWAY, LONG ACRE SQUARE, NEW YORK

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.
Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

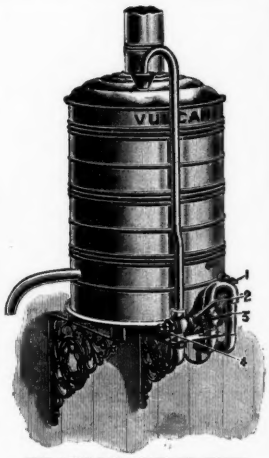
HENRY MARQUAND & CO.,

BANKERS

AND

BROKERS.

160 Broadway, New York City.



THE "VULCAN" INSTANTANEOUS

WATER HEATER No. 25.

Best Yet!
Built of copper throughout, then nickel plated.
Outlet either right or left hand side.
Fitted with duplex taps, insuring absolute safety.
Catalogue No. 17 gives particulars. Want it?
Everything in gas appliances and fittings manufactured by

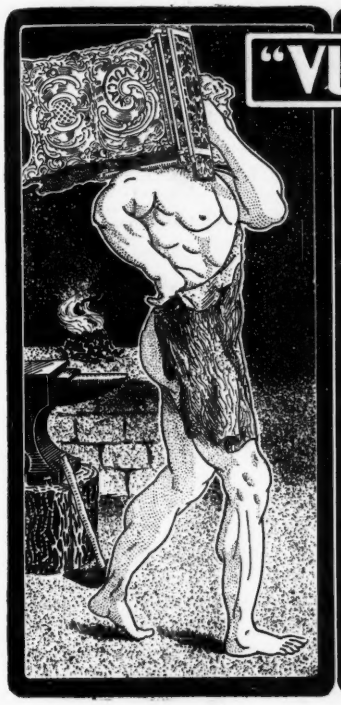
W. M. CRANE CO.,
1131 & 1133 Broadway, New York.
Foundry: Peekskill, N. Y.

KENTUCKY CANNEL COAL, FOR GAS AND DOMESTIC USE.

GEO. R. HISLOP, F.C.S., F.R.S.S.A., Gas Engineer of Paisley, Scotland, says in his analysis: "This is a remarkably rich Cannel Coal, yielding illuminating matter per ton equivalent to 1,945 lbs. of sperm candles."
This coal mined and shipped in box cars. Write for sample car and delivered price.

The Greasy Creek Cannel Coal and Tramway Co.,

163 WEST WASHINGTON STREET, CHICAGO, ILLS.



"VULCAN" GAS APPLIANCES

ANNOUNCEMENT.

Our New Catalogue of Heating Appliances will be issued and mailed in the next few days.

If you do not receive a copy, please notify us.

WM. M. CRANE COMPANY,

1131-1133 Broadway, New York.

Gas Appliances for Heating, Cooking and Manufacturing Purposes.

FOUNDRY: PEEKSKILL, N. Y.

"THE MINER"

Globe Street and Boulevard Lamps.

Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

THOMAS T. W. MINER,

821-823 Eagle Av., N.Y.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

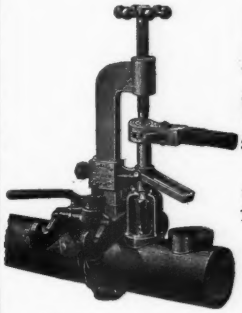
Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.

Geo. Light,

DAYTON, O.



Special Attachment, B-109.

AN INSURANCE POLICY.

TO any manager who is thinking of liability insurance, we would like to show this kind of a machine.

It is a safe machine to work with, your men are safe, and you have a good policy for their protection from asphyxia.

CATALOGUE OF MUELLER MACHINES FROM

H. MUELLER MFG. COMPANY,

DECATUR, ILLS.

Hazelton Water Tube Boilers.

HIGH PRESSURE.

The Pioneer Vertical Water-Tube Boiler of the World.

Over 11½ Square Feet of Heating Surface per Horse Power.

High Quality and Durability of the Tubes the Most Vital Part of a Boiler.

Fastened at One End Only, Expand and Contract Without Strain, Averting any Possibility of Leakage.

Boilers we Built have been in Constant Use 18 Years, and are in Operation To-day with Fine Results.

10 to 25 Per Cent. Guaranteed Over Other Boilers

Strong, Natural, Upright Draft, Consuming All Kinds of Fuel. Absolutely Dry Steam.

Small Floor Space, Less per Horse Power than for Any Other Boiler.

The HAZELTON BOILER CO.

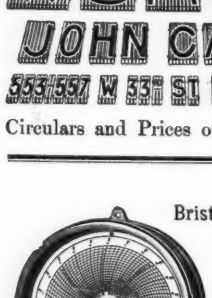
SOLE PROPRIETORS AND MANUFACTURERS,

120 Liberty St., N.Y. Telephone, 4194 Cortlandt

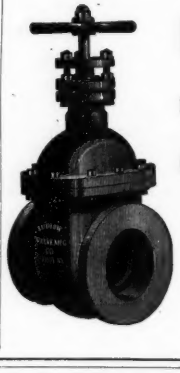
Cable Address, "Falls," N. Y.

TRAYS
FOR
GAS
WORKS
JOHN CABOT
553 557 W 33rd ST NEW YORK
Circulars and Prices on Application.

CHAPMAN VALVE MANUFACTURING CO.
MANUFACTURERS OF
Valves and Gates for Gas, Ammonia, Water, Etc.
Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.
Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.



Bristol's Recording
PRESSURE GAUGE.
For continuous records of Street Gas Pressure.
Simple in construction, accurate in operation, and low in price.
Fully Guaranteed. Send for Circulars.
THE BRISTOL CO.,
Waterbury, Conn.



THE
Ludlow Valve Mfg. Co.,
TROY, N. Y., U. S. A.
Double and Single Gate Valves, ¼" to 72",
—FOR—
Gas, Water, Steam, Oil, Ammonia, Etc.
HOT GAS VALVES A SPECIALTY.
Send for Catalogue.

CHRIS. CUNNINGHAM & SON,
PROPRIETORS
THE NOVELTY STEAM BOILER WORKS,
BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,
To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

W. H. PEARSON, Prest. W. H. PEARSON, Jr., Vice-President. J. T. WESTCOTT, M.E., Manager. L. L. MERRIFIELD, M.Inst.M.E., Chief Engineer.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION CO., LD.

American Offices: 269 FRONT STREET, EAST, TORONTO, ONT.

London Offices: 19 ABINGDON STREET, WESTMINSTER, S.W.

Telegraphic Address: "CARBURETED LONDON AND TORONTO."

The above Company have erected since 1893, or are now erecting, their universal type of Carbureted Water Gas Plants at the following Gas Works:

	Cubic Feet Daily.
Blackburn, England	1,250,000
Windsor Street Works, Birmingham, England	2,000,000
Saltley Works, Birmingham, England	2,000,000
Colchester, England	300,000
Birkenhead, England	2,250,000
Swindon (New Swindon Gas Company), England	120,000
Saltley Works, Birmingham, England (Second Contract)	2,000,000
Windsor Street Works, Birmingham, England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled)	250,000
Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, England (Second Contract)	300,000
York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
Crystal Palace District, England	2,000,000
Duluth, Minn.	300,000
Caterham, England	150,000
Enschede, Holland	150,000
Leicester, England	2,000,000
Buenos Ayres (River Platte Co.)	1,700,000
Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
Accrington, England	500,000
Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000

Steward Burners.

Closest Attention to Durability, Candle Power, Finished Appearance.

Samples to be Had for the Asking.

Write for neat vest pocket memorandum book. Sent Free.

The D. M. Steward Mfg. Co.,

New York Office, 107 CHAMBERS ST. CHATTANOOGA, Tenn.

—THE—

Valuation of Gas, Electricity and Water Works

FOR ASSESSMENT PURPOSES.

SECOND EDITION.

By THOS. NEWBIGGING, M.Inst.C.E., and WM. NEWBIGGING, Assoc.M.Inst.C.E.

With an Appendix of Decided Cases.

Price $2. For Sale by

A. M. CALLENDER & CO.,
32 Pine Street, N. Y. City.

Practical Photometry.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

The Gas Engineer's Laboratory Handbook.

BY JOHN HORNBY, F.I.C. Price, $2.50.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

By HERMAN POOLE, F.C.S.

Second Edition. Price, $3. For Sale by

A. M. CALLENDER & CO., 32 PINE ST., N.Y. CITY.

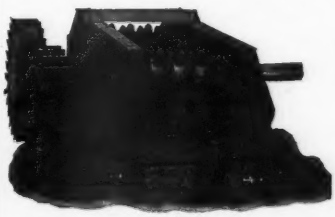
SAFETY GAS MAIN STOPPER CO.

108 EAST 117TH ST., N. Y.

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,
Chicago, U. S. A.



"Link-Belt" Breaker.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Tilting Coal and Coke Cars, Breaker Rolls, Shaking Screens, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

CATALOGUE UPON APPLICATION.

Sutherland Construction & Improvement Co.

Offices: 15 WALL ST., NEW YORK, and OSHKOSH, WISCONSIN.

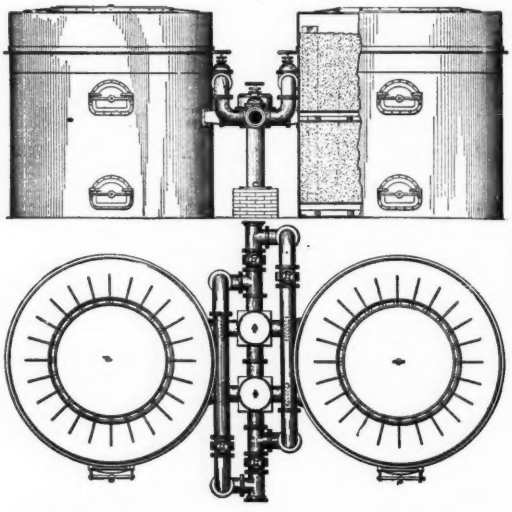
Owners of the "SUTHERLAND" Patents for Water Gas Apparatus.

Gas, Electric Light, Water Works, and Electric Street Railways Built, Remodeled, Operated, Bought and Sold.

A few of the places where the SUTHERLAND Apparatus is in successful operation:

Ilion, N. Y.
Herkimer, N. Y., 2 orders.
Little Falls, N. Y.
Fishkill-on-Hudson, 2 orders.
Clifton Springs, N.Y., 2 orders.
Green Bay, Wis.
Stevens Point, Wis.
Tarrytown, N.Y., 3 orders.
Ft. Henry, N. Y.
Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
Mendota, Ill.
Circleville, O.
Joplin, Mo.
Ashville, N. C.
Youngstown, O.
Kingston & Rondout, N. Y.

CORRESPONDENCE SOLICITED.



CHOLLAR'S SYSTEM OF GAS PURIFICATION.

Covered by Five U. S. Patents.

In operation, revivification of the oxide is effected by repeated reversals of the direction of the flow of the gas through the beds (in the two boxes used under this system there are eight different routes for the gas to take) whereby the purified gas is made to revive the oxide in parts of the apparatus while the foul gas is fouling it in others.

The boxes are charged or discharged from the sides as well as the top.

There are no Hydraulic Cups or heavy covers.

Either end of the apparatus is inlet or outlet at pleasure.

The capacity is increased five-fold or more over ordinary methods without addition to building.

The apparatus costs less than for any other system.

For Estimates Write **The Stacey Mfg. Co.,**
SOLE MANUFACTURERS,
FOR FURTHER INFORMATION WRITE **CINCINNATI, OHIO.**
B. E. CHOLLAR, 411 N. 11th St., St. Louis, Mo.

Coal Tar Genealogical Tree.

Mr. T. Viner Clarke, of London, Eng., having compiled a novel Chart or Map illustrating the various CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR, in the form of a Genealogical Tree, including all the products discovered (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., No. 32 Pine Street, New York.

AMERICAN BRIDGE CO.,

Designers and Builders of Steel Bridges, Steel Buildings and All Classes of Metallic Structures.

GENERAL OFFICES.

No. 100 Broadway, New York.

BRANCH OFFICES.

Boston, Philadelphia, Chicago,
Pittsburg, Baltimore,
New Orleans, Cleveland, Minneapolis.

FIELD'S ANALYSIS

For the Year 1899.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the Thirtieth Year of Publication.

Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Co., London.

Price $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

EASTERN AGENTS FOR

BREDEL'S SYSTEM
COAL GAS PLANTS AND GAS APPARATUS.

P. H. & F. M. ROOTS CO.'S
Exhausters, Governors, etc.

GENERAL AGENTS FOR

BRONDER'S CHARGING AND DISCHARGING MACHINES.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

FRED. BREDEL, C.E.

Coal and Water Gas Plants.

OWN SYSTEM.

RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

SOLE UNITED STATES AGENT FOR
ARROL-FOULIS MECHANICAL CHARGING AND DRAWING MACHINES.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

No. 118 Farwell Avenue, · Milwaukee, Wis.

Eastern Agents: AMERICAN GAS CO., Construction Department, 222 So. 3d St., Phila., Pa.

ROOTS'

LATEST IMPROVED GAS EXHAUSTER

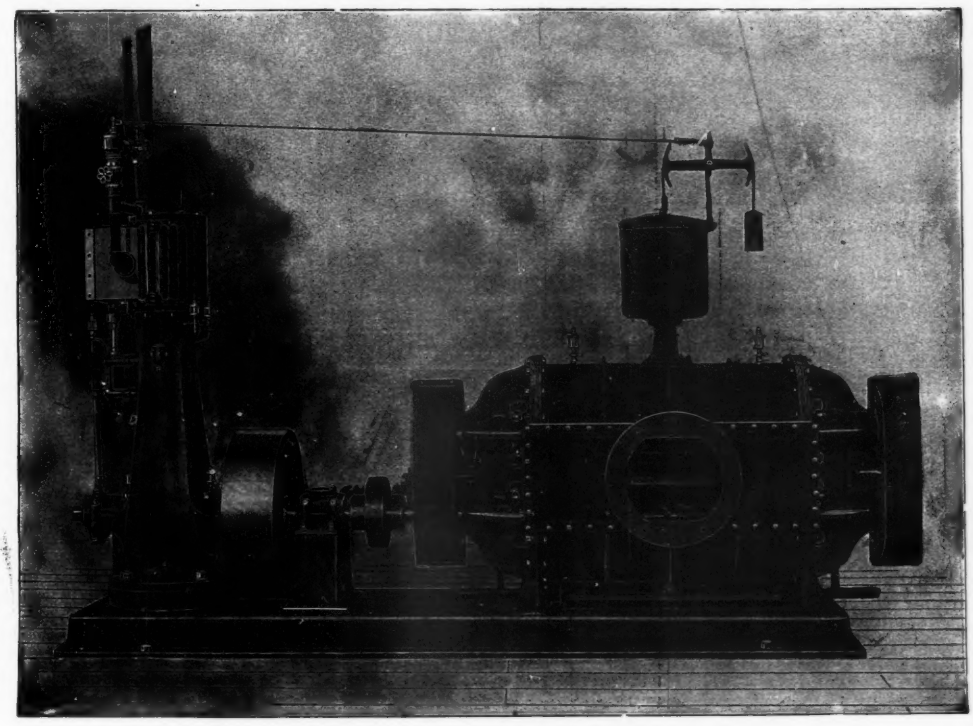
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



INQUIRIES CHEERFULLY ANSWERED. WRITE FOR CATALOGUE.

P. H. & F. M. ROOTS CO.,

Connersville, Ind. 109 Liberty St., New York.

Eastern Office:

American Gas Company,

222 South Third Street, Philadelphia, Pa.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

From Three to Forty-Eight Inches Diameter. Also, all Sizes of

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc

"Close Specials Reverse Etc." "Clamorgan" Fire Hydrants

M. J. DRUMMOND & CO.

MANUFACTURERS OF

CAST IRON

FLANGE

GAS and WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

Western Office: Monadnock Block, Chicago, Ills.

George Ormrod, Manst. & Treas., Emaus, Pa.
John Donaldson, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS PA.

CAST IRON GAS & WATER PIPE

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Sluice Gates, Pig Lead, Jute, etc.

UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

CAST IRON PIPE and SPECIALS FOR WATER AND GAS.

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

CORNELL & UNDERHILL,

Wrought & Cast Iron Pipe,

MALLEABLE AND CAST IRON FITTINGS,

Brass and Iron Cocks and Gate Valves,

43, 45 AND 47 BEACH ST., NEW YORK.

BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, N.Y.

PRACTICAL PHOTOMETRY.

A Guide to the Study of the Measurement of Light.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00. A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

WITH A VERY FULL COLLECTION OF TABLES OF HEATS OF COMBUSTION OF FUELS, SOLID LIQUID AND GASEOUS.

TO WHICH IS ALSO APPENDED

THE REPORT OF THE COMMITTEE ON BOILER TESTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS DECEMBER (1897); TABLES OF CONSTANTS USED.

By HERMAN POOLE, F.C.S.

Second Edition. Price $8. For Sale by

A. M. CALLENDER & CO. - - No. 32 Pine Street, New York City.

THE GAS ENGINEER'S POCKET-BOOK.

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

Price, - - $3.50.

A. M. CALLENDER & COMPANY, No. 32 Pine Street, N. Y. City.

(Copyrighted, 1894, by the AMERICAN METER CO.

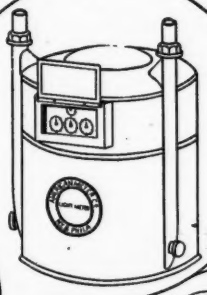
AMERICAN METER CO.

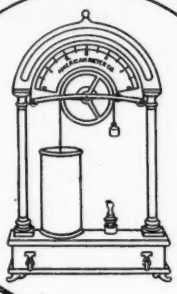
ESTABLISHED 1836. INCORPORATED 1865.

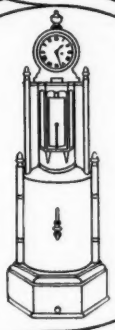
NEW YORK AND PHILADELPHIA,

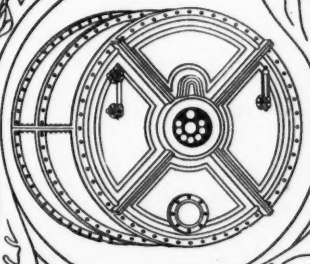
CHICAGO, ST. LOUIS,

SAN FRANCISCO.









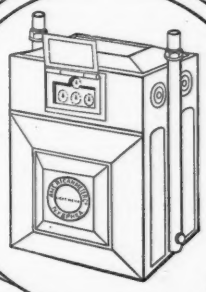
PUBLIC LIGHTING TABLE.

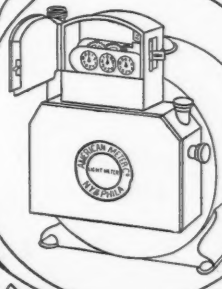
AUGUST, 1900.

Day of Week.	Table No. 1. FOLLOWING THE MOON.			Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING.	
	Date.	Light.	Extinguish.	Light.	Extinguish.
				P.M.	A.M.
Wed.	1	8.50 PM	4.00 AM	7.10	3.30
Thu.	2	9.20	4.00	7.10	3.30
Fri.	3	10.00 FQ	4.00	7.10	3.30
Sat.	4	10.40	4.00	7.10	3.30
Sun.	5	11.30	4.10	7.10	3.30
Mon.	6	12.20 AM	4.10	7.10	3.45
Tue.	7	1.30	4.10	7.10	3.45
Wed.	8	2.30	4.10	7.10	3.45
Thu.	9	No L.	No L.	7.10	3.45
Fri.	10	No L. FM	No L.	7.10	3.45
Sat.	11	No L.	No L.	7.10	3.45
Sun.	12	7.30 PM	8.50 PM	7.10	3.45
Mon.	13	7.30	9.20	6.55	4.00
Tue.	14	7.30	10.00	6.55	4.00
Wed.	15	7.30	10.30	6.55	4.00
Thu.	16	7.30 LQ	11.20	6.55	4.00
Fri.	17	7.30	12.00	6.55	4.00
Sat.	18	7.30	12.50 AM	6.55	4.00
Sun.	19	7.20	1.50	6.55	4.00
Mon.	20	7.20	2.50	6.45	4.10
Tue.	21	7.20	4.20	6.45	4.10
Wed.	22	7.20	4.20	6.45	4.10
Thu.	23	7.20	4.20	6.45	4.10
Fri.	24	7.20 NM	4.20	6.45	4.10
Sat.	25	7.20	4.20	6.45	4.10
Sun.	26	7.10	4.20	6.45	4.10
Mon.	27	7.10	4.20	6.30	4.20
Tue.	28	7.10	4.20	6.30	4.20
Wed.	29	7.20	4.20	6.30	4.20
Thu.	30	8.00	4.20	6.30	4.20
Fri.	31	8.40	4.20	6.30	4.20

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr	2221.40	Total, yr	3987.45





NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....

No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

No. 38.

Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

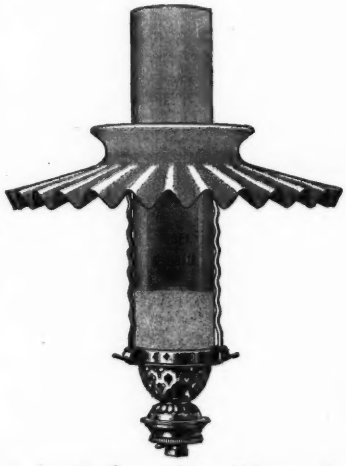
"Yusea" Welsbach Mantle

FINEST EXAMPLE

OF INCANDESCENT

GAS LIGHT

EVER EXHIBITED.



OTHER WELSBACH BRANDS

—OF—

Magnificent Brilliancy

—AND—

Endurance.

THE HIGHEST ILLUMINATION,

The Lowest Cost.

Welsbach Lamps, Mantles, and Complete Line of Glassware and Supplies.

WELSBACH COMPANY,

GLOUCESTER, N. J.

Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD JUNIOR,

THE STANDARD DOUBLE SUPERHEATER,

LOWE WATER GAS APPARATUS.

Total Sets Installed to January 1, 1900, - - - - - - - - 327

Total Daily Capacity - - - - - - - - - 207,425,000 Cu. Ft.

WATER GAS PLANT AS AUXILIARY TO COAL GAS WORKS.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D ABERNETHY. Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

E. D. WHITE, President. A. H. GUTKES, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St. Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { CAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office:
914, 915 & 916 Wainwright Building, St. Louis, Mo.

The Construction of Gas Works

PRACTICALLY DESCRIBED,

By WALTER RALPH HERRING.

Price $2. For Sale by

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works,
LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR., CO.,

Hamilton Building, Fifth Avenue,
PITTSBURGH, PA. P. O. Box 373.

Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg or Brooklyn.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

Eastern Agent, GEO. P. WARRINER, 675 Bedford Ave., BROOKLYN, N. Y.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12 x 12 x 2 and 10 x 10 x 2.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

— MANUFACTURERS OF —

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are prepared to furnish and erect COMPLETE, Half and Full Depth Benches of 6's, 8's, 9's, with Regenerative Furnaces, Constructed to Burn either Coal or Coke. Also Plain Benches.

CORRESPONDENCE IS RESPECTFULLY SOLICITED.

{ CITY OFFICE: 411 Olive St., Continental Bank, } ST. LOUIS, MO.

National Gas and Water Company.

CONTRACTORS FOR
Gas Plant Machinery

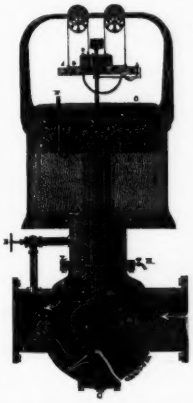
SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

218 LA SALLE ST.,
CHICAGO.

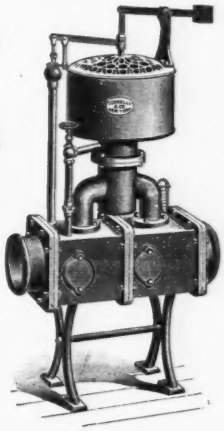
Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
REPAIRS.

GAS WORKS SPECIALTIES,



AUTOMATIC STREET GAS GOVERNORS,
BALANCE GAS GOVERNORS.
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



Connelly Iron Sponge & Governor Co.

No. 357 CANAL STREET,
NEW YORK CITY.

WESTERN BRANCH CONNELLY IRON SPONGE & GOVERNOR CO.,
788 South Canal Street, Chicago, Ills.

Hughes'
"Gas Works,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.

Rewritten and Much Enlarged by
WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements.

Price, $1.65.

A. M. CALLENDER & CO.,
32 Pine St., N. Y. City.

Parson's Steam Blower

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., 457 Putnam Ave., Brooklyn, N. Y.

The Chemistry of Illuminating Gas,
By NORTON H. HUMPHRYS. Price, $2.40.
A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

The Gas Engineer's Laboratory Handbook,
By JOHN HORNBY, F.I.C.
Price, $2.50.
A. M. CALLENDER & CO., 32 Pine Street N Y. City

Practical Hints on the Construction and Working of Regenerator Furnaces,
By MAURICE GRAHAM, Assoc. M. Inst. C.E.
Price, $1.25. For Sale by
A. M. CALLENDER & CO., No. 32 Pine Street, New York City.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, THE CHEMISTRY OF, by W. J. A. Butterfield. $3.50.

NEWBIGGING'S HANDBOOK. By Thos. Newbigging. 6th edition. $6.

COX'S GAS FLOW COMPUTER. $2.50.

FIELD'S ANALYSIS, 1898. $5.

HUGHES' GAS WORKS. $1.65.

POOLE ON FUELS. By Herman Poole. $3.

GAS ENGINEER'S POCKET-BOOK. By Henry O'Connor. $3.50.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards. 90 cents.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

HEMPEL'S GAS ANALYSIS, $2.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

GASFITTER'S GUIDE, by John Eldridge 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2

CONSTRUCTION OF GAS WORKS, by Walter Ralph Herring. $2.

DIGEST OF GAS CASES. $5.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT: A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

A COMPARISON BETWEEN THE ENGLISH AND FRENCH METHODS OF ASCERTAINING THE ILLUMINATING POWER OF COAL GAS. $1.00.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Kapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point Baltimore, Md.
OFFICE, - 640 Equitable Building Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS. { BANGS & HORTON 60 Congress St., Boston.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50. For sale by

A. M. Callender & Co., 32 Pine St., N. Y.

GREENOUGH'S "DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., N. Y.

MADEIRA, HILL & CO.,

INCORPORATED.

MINERS AND SHIPPERS

Anthracite and Bituminous Coal and Coke.

GENERAL EASTERN SALES AGENTS

PENN GAS COAL CO.

OPERATING THE FAMOUS MINES IN THE

YOUGHIOGHENY COAL BASIN.

OWNERS OF OVER 1,000 COAL CARS.

COAL CAREFULLY SCREENED AND PREPARED FOR GAS PURPOSES.

OFFICES:

PHILADELPHIA, 32 South Broad Street. BOSTON, 70 Kilby Street. NEW YORK, 143 Liberty Street.
BRIDGEPORT, CONN. READING, PA.

EDMUND H. McCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

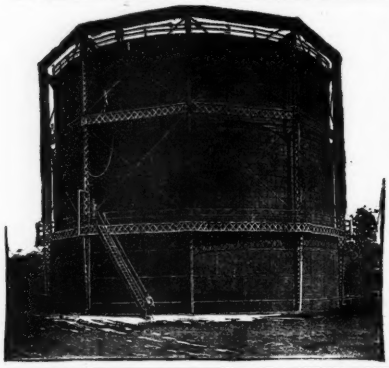
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,
WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,
CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

CORRESPONDENCE SOLICITED.

OFFICE: WAYNE COUNTY BANK BUILDING, ooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,
Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

Geo. Shepard Page's Sons.
GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

JAMES T. LYNN,
GAS ENGINEER
AND
CONTRACTOR,

Wayne Bank Building, - DETROIT

GAS PROPERTIES PURCHASED.

DAVID LEAVITT HOUGH,
Consulting Engineer
AND
CONTRACTOR,

374 FIFTH AVE., N. Y

Kerr Murray Manufacturing Company,

Steel Gasholder Tanks,

SINGLE, DOUBLE AND TRIPLE-LIFT GASHOLDERS,

HORIZONTAL AND VERTICAL STORAGE OIL TANKS

Iron Work for Coal Gas Benches, Self-Sealing Mouthpieces, Exhausters, Condensers, Scrubbers, Purifiers, Wooden Trays, Floor Carriages, Center Seal and Valve System Connections, Cast and Wrought Iron Fittings, and Connections 3 to 36 Inches Diameter.

VALVES, Double Gate, Hub and Flange, Outside Screw and Quick Opening, 3 to 36 In. Diam.

COAL AND COKE WAGONS, RETORT HOUSE TOOLS, STREET MAIN SPECIALS AND DRIPS.

Address,

KERR MURRAY MANUFACTURING CO.
Fort Wayne, Indiana.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

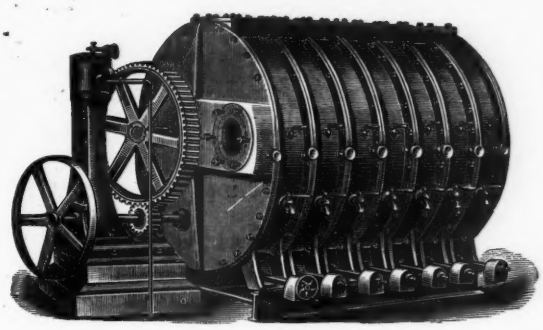
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

ALEX. C. HUMPHREYS, M. E., M. Inst. C. E. ARTHUR G. GLASGOW, M. E., M. Inst. C. E.

HUMPHREYS & GLASGOW,

BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

9 VICTORIA STREET, London S. W., England.

CONSULTING GAS ENGINEERS AND MANAGERS.

GAS PROPERTIES PURCHASED.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND.

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

R. D. WOOD & CO.,

400 CHESTNUT ST., PHILADELPHIA,

Producer Gas Power Plants,

—WITH—

GAS PRODUCERS.

The best Producer for either Bituminous, Anthracite Coal or Lignite. Less labor required and less waste than any other Producer. Patented in the United States and all Foreign Countries. Send for Pamphlet.

HYDRAULIC TOOLS. **CAMDEN HIGH PRESSURE VALVES.**

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

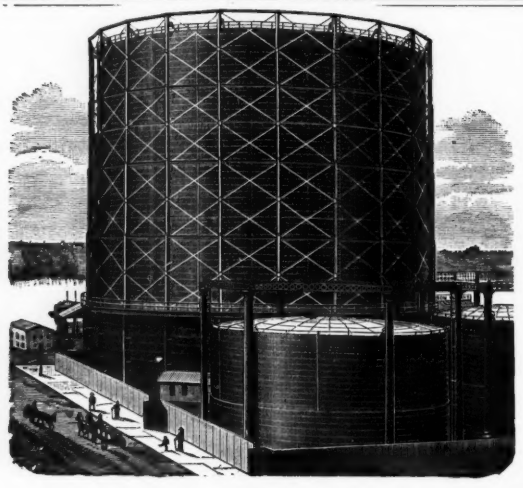
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. OFFICES **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cuttlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

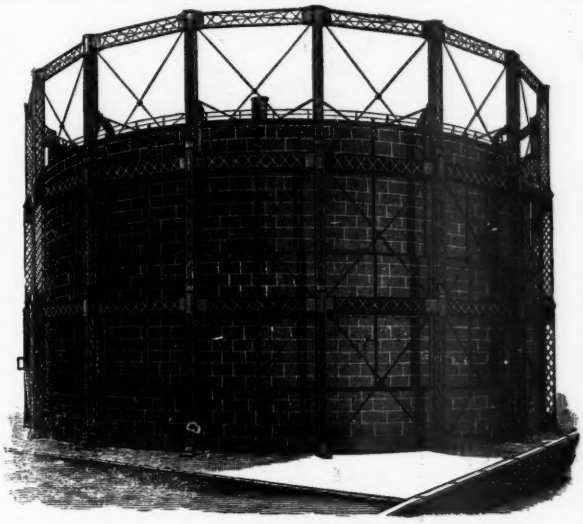
BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.



WILLIAM STACEY, Prest. T. H. BIRCH, Asst. Mangr.
J. E. STACEY, Vice-Prest. & Gen. Mangr. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO.

Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

General Office: Cincinnati, O.
Eastern Office: 911 Drexel Building, Philadelphia, Pa.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

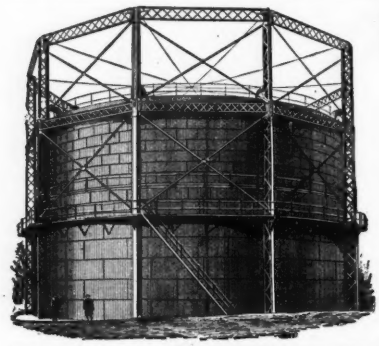
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.

1900 DIRECTORY 1900

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.



1842 ❊ Deily & Fowler, ❊ 1900

LAUREL IRON WORKS.

Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.

James R. Floyd's Sons,

FREDERICK W. FLOYD, President.
HENRY E. FLOYD, Vice-President.
JAMES R. FLOYD, Jr., Sec'y & Treas.

531 to 543 West 20th Street and 530 to 540 West 21st Street, N. Y.

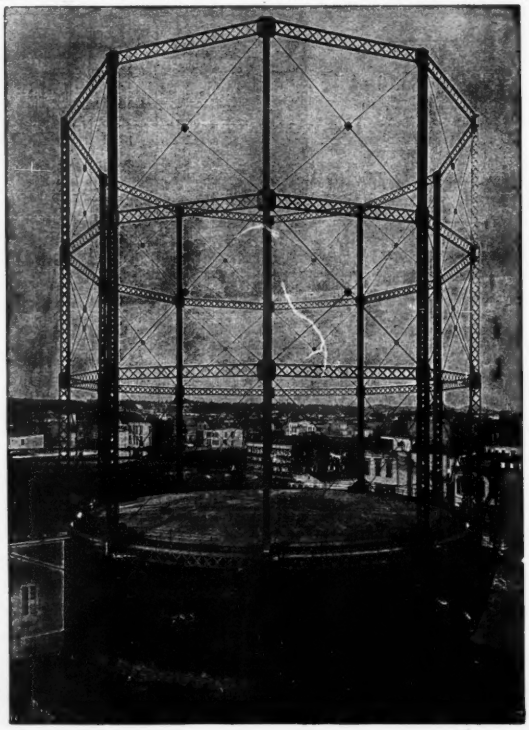
Engineers and Contractors for the Construction of Gas Works.

MANUFACTURERS OF

All Kinds of Castings and Iron Work for Gas Apparatus.

ESTABLISHED 1856.
INCORPORATED 1894.

Write for Estimates to
530. West 20th St.. New York Citv.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu.Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,
CONDENSERS,
PURIFIERS, IRON ROOFS,
Self-Sealing Retort Lids,
AND ALL PARTS OF
GAS WORKS APPARATUS.

Contractors for
Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S
HOT GAS SCRUBBER.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 50,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | 34 & 36 West Monroe Street, CHICAGO.

NOW READY.

THE SIXTH (AND CENTENARY) EDITION

— OF THE —

Handbook for Gas Engineers and Managers.

By THOMAS NEWBIGGING, M. Inst. C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

PRICE, - - $6.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, N. Y. City.

PRACTICAL HANDBOOK ON

GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS METER CO.,

8 Medford Street, Boston, Mass.

MANUFACTURERS OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Prepayment Gas Meters.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**

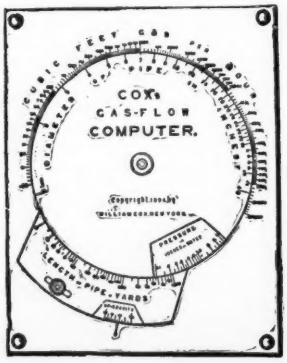
SAN FRANCISCO, 221 Front St.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

KEYSTONE METERS, CAREFULLY MADE.

The KEYSTONE METER CO., Royersford, Pa. and WIESTER & CO., 22 Second St., San Francisco.



Do you wish to Know

what size of Pipe to use to convey any quantity of Gas, any distance, with any loss of pressure, and any initial or final pressure? Then use

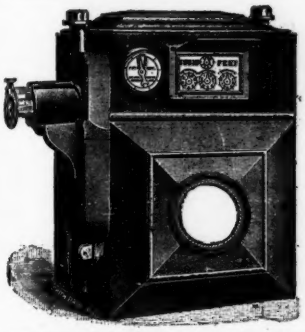
COX'S GAS FLOW COMPUTER,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.



AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, SAN FRANCISCO.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

A 28-page Pamphlet containing the cream of this Board's decisions as to the proper management of Gas Companies.

Compiled by E. H. YORKE. Price $1.00. Address

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

The advertisement of

THE WESTERN GAS CONSTRUCTION COMPANY, Engineers and Builders,

Improved Double Superheater Lowe Water Gas Apparatus—Manufacturers of General Gas Works Machinery—Builders of Gas Works

WM HENRY WHITE, Eastern Engineer, 32 Pine St., New York.

FORT WAYNE, IND.,

Occupies this space every alternate week.

JOHN J. GRIFFIN & CO.,

1513-1515-1517-1519-1521 Race Street, Philadelphia.

52 Dey Street, New York. WM. S. GRIBBEL, Manager.

75 N. Clinton St., Chicago. FREDERICK WAUGH, Manager.

MANUFACTURERS OF

STATION METERS, CONSUMERS' METERS,

Provers, Registers, Gauges, Experimental Apparatus, Etc.

Prompt Attention Given to All Repairing.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 30,000 now in use.

We manufacture in the United States, under the **SAWER & PURVES PATENTS**, the

Positive Prepayment Meter.

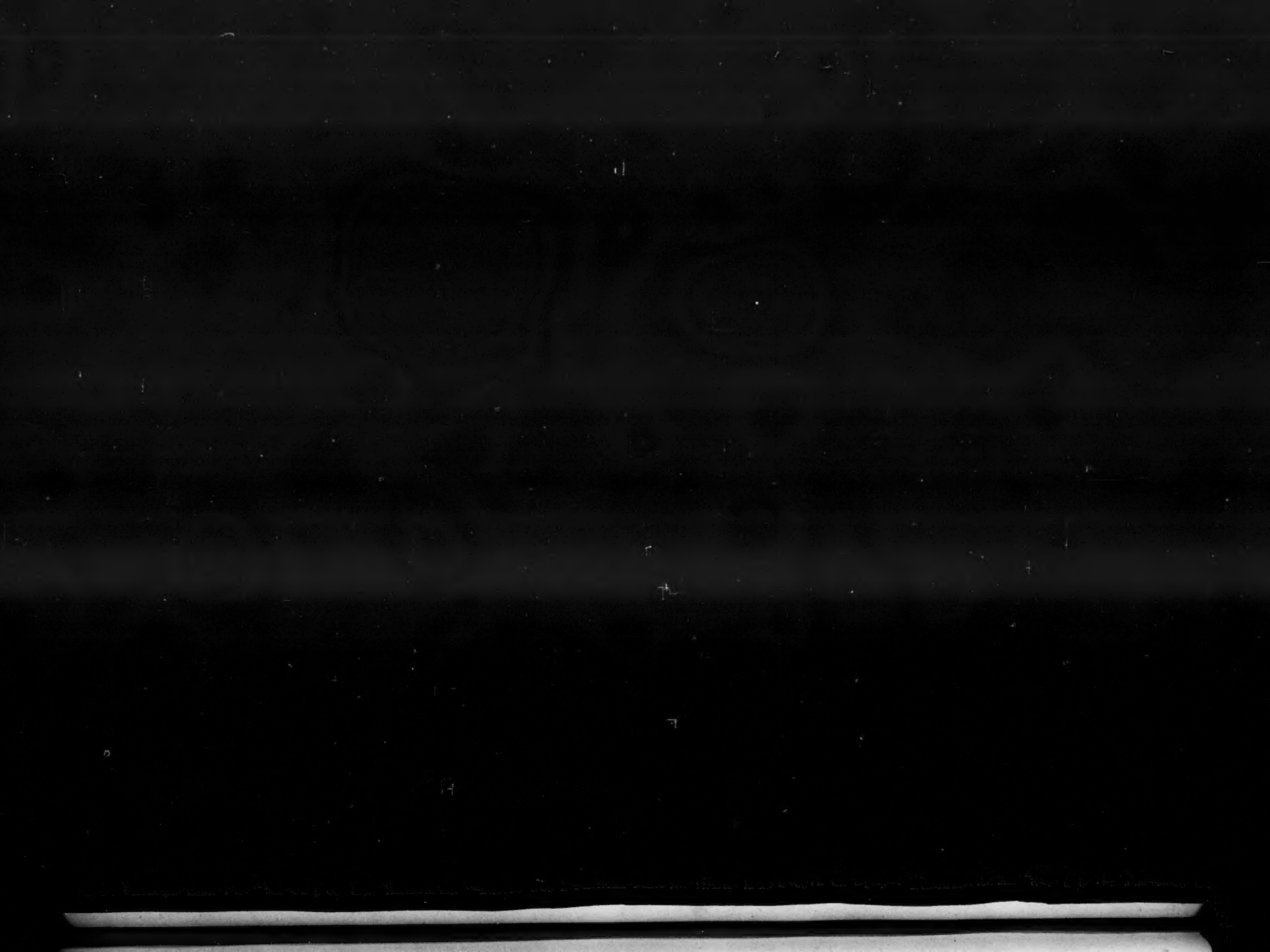
. . SIMPLE . .

. DURABLE .

. ACCURATE .

. RELIABLE .

All Parts Interchangeable

This Meter is an unqualified success in Great Britain. Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

Needs Only the Care Given an Ordinary Meter.
Saves MONEY, TIME and CONSUMERS.
Dispenses with "DEPOSITS" and Increases OUTPUT.